Mary Hollinger

NOAA Technical Report NESDIS 13

Summary and Analyses of the NOAA N-ROSS/ ERS-1 Environmental Data Development Activity

Washington, D.C.
April 1985

U.S DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Environmental Satellite, Data and Information Service

NOAA TECHNICAL REPORTS

National Environmental Satellite, Data, and Information Service

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A more complete listing of these reports, by title and NTIS accession number, is available from the Assessment and Information Services Center, National Oceanic and Atmospheric Administration, Code E/AI13, Page Bldg. 2, 3300 Whitehaven Street, N.W., Washington, DC 20235. A partial listing of more recent reports appears below:

NESS Series

NESS 89 A Statistical Approach to Rainfall Estimation Using Satellite and Conventional Data. Linwood F. Whitney, Jr. April 1982. (PB82 215435)

NESS 90 Total Precipitable Water and Rainfall Determinations From the SEASAT Scanning Multichannel Microwave Radiometer (SMMR). John C. Alishouse, May 1982. (PB83 138263)

NESS 91 Numerical Smoothing and Differentiation by Finite Differences. Henry E. Fleming and Lawrence J. Crone, May 1982. (PB82-258385)

NESS 92 Satellite Infrared Observations of Oceanic Long Waves in the Eastern Equatorial Pacific 1975 to 1981. Richard Legeckis, November 1982. (PB83 161133)

NESS 93 A Method for Improving the Estimation of Conditional Instability from Satellite Retrievals. W.E. Togstad, J.M. Lewis, and H.M. Woolf, November 1982. (PB83 169938)

EDIS Series

EDS 29 GATE Convection Subprogram Data Center: Final Report on Rawinsonde Data Validation. Robert W. Reeves, March 1978. (PB-281-861)

EDS 30 Gamma Distribution Bias and Confidence Limits. Harold L. Crutcher and Raymond L. Joiner, September 1978. (PB-289-721)

EDIS 31 Calibration and Intercomparison of the GATE C-Band Radars. M. Hudlow, R. Arkell, V. Patterson, P. Pytlowany, F. Richards, and S. Geotis (MIT), November 1979. (PB81 120305)

EDIS 32 Distribution of Radiosonde Errors. Harold L. Crutcher, May 1979. (PB-297-383)

EDIS 33 Accurate Least-Squares Techniques Using the Orthogonal Function Approach. Jerry Sullivan, March 1980. (PB80 223241)

EDIS 34 An Application of Stochastic Forecasting to Monthly Averaged 700 mb Heights. Albert Koscielny, June 1982. (PB82 244625)

NESDIS Series

NESDIS 1 Satellite Observations on Variations in Southern Hemisphere Snow Cover. Kenneth F. Dewey and Richard Heim, Jr., June 1983. (PB83 252908)

NESDIS 2 NODC 1 An Environmental Guide to Ocean Thermal Energy Conversion (OTEC) Operations in the Gulf of Mexico. National Oceanographic Data Center (DOC/NOAA Interagency Agreement Number EX-76-A-29-1041), June 1983. (PB84 115146)

NESDIS 3 Determination of the Planetary Radiation Budget From TIROS-N Satellites. Arnold Gruber, Irwin Ruff, and Charles Earnest, August 1983. (PB84 100916)

NESDIS 4 Some Applications of Satellite Radiation Observations to Climate Studies. T. S. Chen, George Ohring, and Haim Ganot, September 1983. (PB84 108109)

NESDIS 5 A Statistical Technique for Forecasting Severe Weather From Vertical Soundings by Satellite and Radiosonde. David L. Keller and William L. Smith, June 1983. (PB84 114099)

(Continued on inside back cover)

NOAA Technical Report NESDIS 13

Summary and Analyses of the NOAA N-ROSS/ ERS-1 Environmental Data Development Activity

John W. Sherman III

Washington, D.C.
April 1985

U.S. DEPARTMENT OF COMMERCE
Malcolm Baldrige, Secretary
National Oceanic and Atmospheric Administration
Anthony J. Calio, Deputy Administrator
National Environmental Satellite, Data, and Information Service
John H. McElroy, Assistant Administrator

NNEEDD

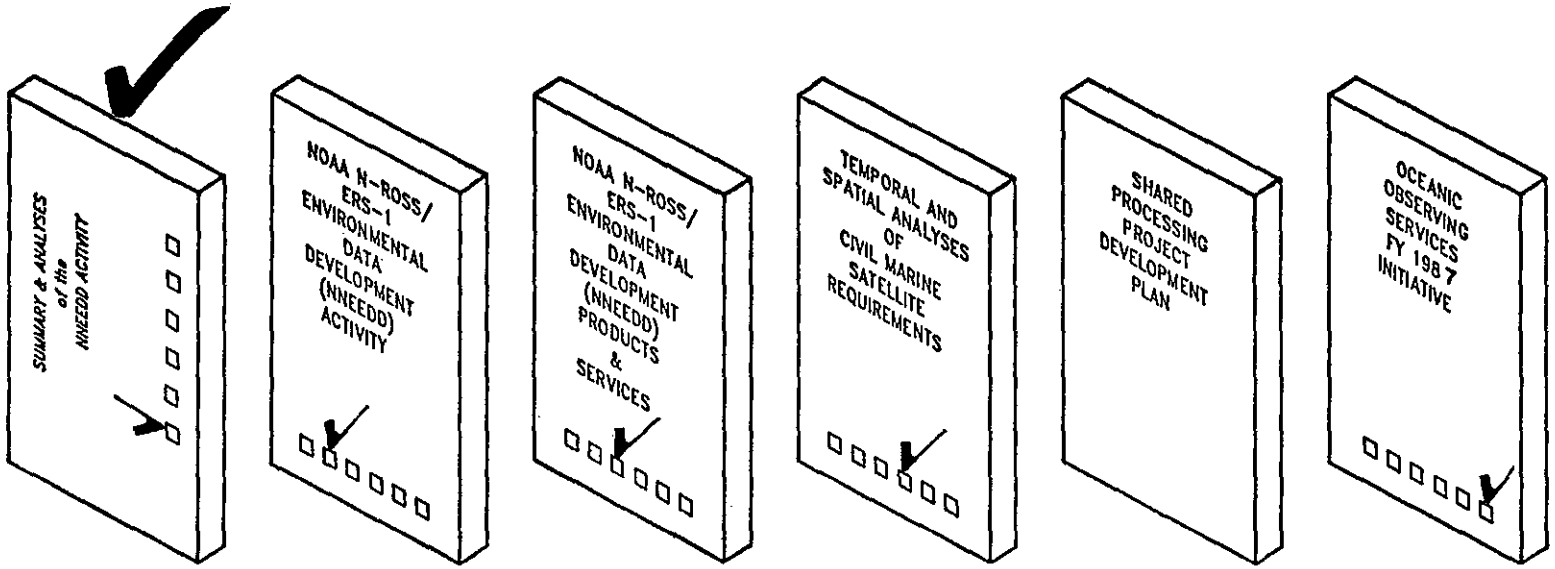
NOAA N-ROSS / ERS-1 ENVIRONMENTAL DATA DEVELOPMENT

Pronounced "NEED"

SUMMARY AND ANALYSES OF THE NNEEDD ACTIVITY

PREFACE

- THIS DOCUMENT SUMMARIZES A FAMILY OF STUDIES CONDUCTED TO DEFINE NOAA'S OPPORTUNITY TO INCREASE THE OCEANIC OBSERVING SERVICES WELL BEYOND THOSE PRESENTLY PROVIDED BY SURFACE OR SATELLITE SYSTEMS.
- THE NNEEDD ACTIVITY ACCOMPLISHES THIS BY PROVIDING A GATEWAY TO OTHER NON-NOAA SATELLITES.
- THE STUDIES IN THIS FAMILY ARE:



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SUMMARY AND ANALYSES

OF THE

NOAA N-ROSS/ERS-1 ENVIRONMENTAL DATA DEVELOPMENT (NNEEDD) ACTIVITY

OUTLINE

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SUMMARY AND ANALYSES OF THE NNEEDD ACTIVITY

OVERVIEW

- BETWEEN LATE 1985 AND MID-1989 MORE THAN ONE BILLION DOLLARS OF SATELLITE SENSORS DESIGNED FOR OCEANIC MEASUREMENTS WILL BE LAUNCHED BY THE U.S. AND FOREIGN SPACE ACTIVITIES.

- NOAA IS NEEDED TO PROVIDE OCEANIC DATA TO THE U.S. CIVIL MARINE COMMUNITY AND FOREIGN-DERIVED SATELLITE DATA TO ALL U.S. DOMESTIC USERS.

- IN THE BASE PROGRAM INITIATIVE, NO SATELLITE HARDWARE IS PROPOSED, ONLY GROUND HARDWARE AND SOFTWARE, DATA VALIDATION AND DISTRIBUTION, ARCHIVING, AND AN APPLICATIONS AND SERVICES ACTIVITY FOCUSED THROUGH THE NOAA OCEAN PRODUCTS CENTER TO PROVIDE INFORMATION TO MARINE AND VALUE-ADDED INDUSTRIES.

- THE PLANNED ENSEMBLE OF SATELLITES INCLUDE:

GEOSAT	LATE 1984 LAUNCH
DMSP	MID-1986
N-ROSS	MID-1989
ERS-1	MID-1989

- OPERATIONAL WIND DATA WILL BE INCREASED FROM ITS PRESENT LEVEL OF 2,000 TO 4,000 REPORTS PER DAY TO 2 TO 4 MILLION REPORTS PER DAY IN THE 1989-1990 TIME FRAME. SIMILARLY GLOBAL WAVE DATA WILL INCREASE FROM ABOUT 2,000 TO 4,000 TO ABOUT 120,000 REPORTS PER DAY, WHILE SEA SURFACE TEMPERATURE REPORTS WILL INCREASE FROM 30,000 TO 70,000 TO ABOUT 650,000 REPORTS PER DAY. SEA ICE INFORMATION WILL HAVE A MAJOR INCREASE IN THIS SAME TIME PERIOD.

- WITHOUT A DOC/NOAA COMMITMENT, THESE DATA WILL NOT BE AVAILABLE TO THE U.S. ACADEMIC, GOVERNMENTAL OR PRIVATE MARINE INTERESTS.

- THE COMMITMENT MUST BE MADE BY 1986 IN ORDER FOR BOTH GOVERNMENTAL AND PRIVATE INDUSTRY PLANNERS TO IMPLEMENT THE DATA SYSTEM TO OPERATIONAL CAPABILITY.

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SUMMARY AND ANALYSES OF THE NNEEDD ACTIVITY

SATELLITE DATA SOURCES

- THE FOLLOWING DIAGRAMS ILLUSTRATE THE SEQUENCE BY WHICH SATELLITE DATA WILL BECOME AVAILABLE OVER THE NEXT SIX YEARS.
- THE PROPOSED PLAN IS AN EVOLUTIONARY ONE GROWING IN DISCRETE STEPS.
- HOWEVER, THE SATELLITE SUPPORT SYSTEM PLANNED BY NOAA IS BASED ON THE OCEANIC NEEDS FOR THE FINAL STEP OCCURRING IN IN 1989-1990 TIME PERIOD.

PRESENT OPERATIONAL SATELLITE OCEANIC INFORMATION SYSTEM

- THE NAVY, THROUGH THE FLEET NUMERICAL OCEAN CENTER (FNOC), MONTEREY, CALIFORNIA, CURRENTLY HAS DAILY ACCESS TO THE AVHRR GLOBAL AREA COVERAGE (GAC) AND SELECTED LOCAL AREA COVERAGE (LAC) DATA.

- NOAA PROVIDES SPECIAL AVHRR DATA COLLECTION (FOR LAC DATA) TO NAVY REQUESTS AS REQUIRED.

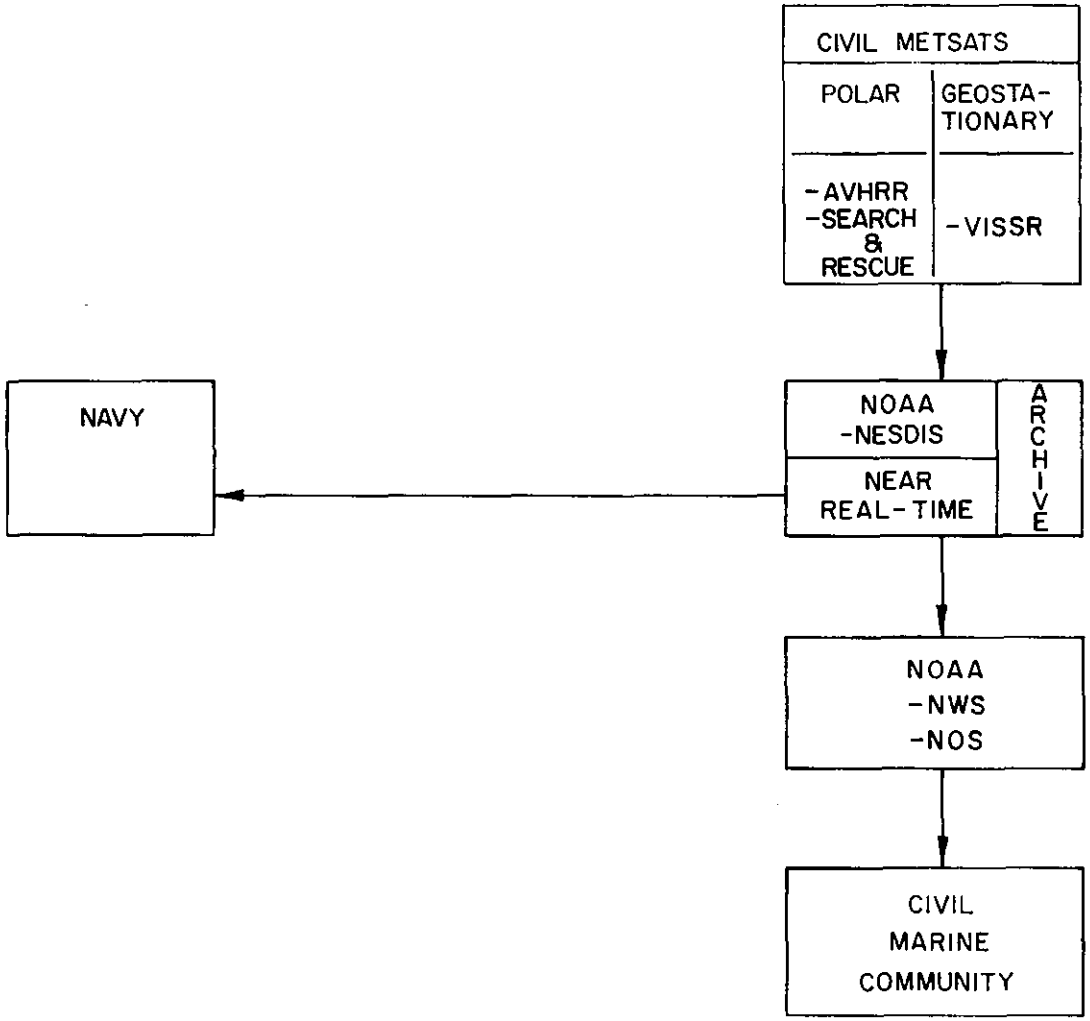
- THE NAVY MAINTAINS SEVERAL GOES-TAPS FOR VISSR DATA.

- THE NAVY RECEIVES MULTICHANNEL SST (MCSST) OBSERVATIONS FROM NESDIS EVERY THREE HOURS VIA THE LINK BETWEEN NMC AND FNOC.

- THE NAVY AND NOAA SHARE IN-SITU AND BUOY DATA USED OPERATIONALLY AND ALSO FOR SATELLITE DATA VALIDATION.

- ALL U.S. CIVIL USERS HAVE ACCESS TO NOAA SATELLITE DATA AND INFORMATION THROUGH DIRECT READ-OUT OR THROUGH THE FACILITIES OF THE NATIONAL WEATHER SERVICE (NWS) OR NATIONAL OCEAN SERVICES (NOS), OR THE NESDIS SATELLITE DATA SERVICES DIVISION (SDSD).

PRESENT OPERATIONAL SATELLITE OCEANIC INFORMATION DISTRIBUTION SYSTEM



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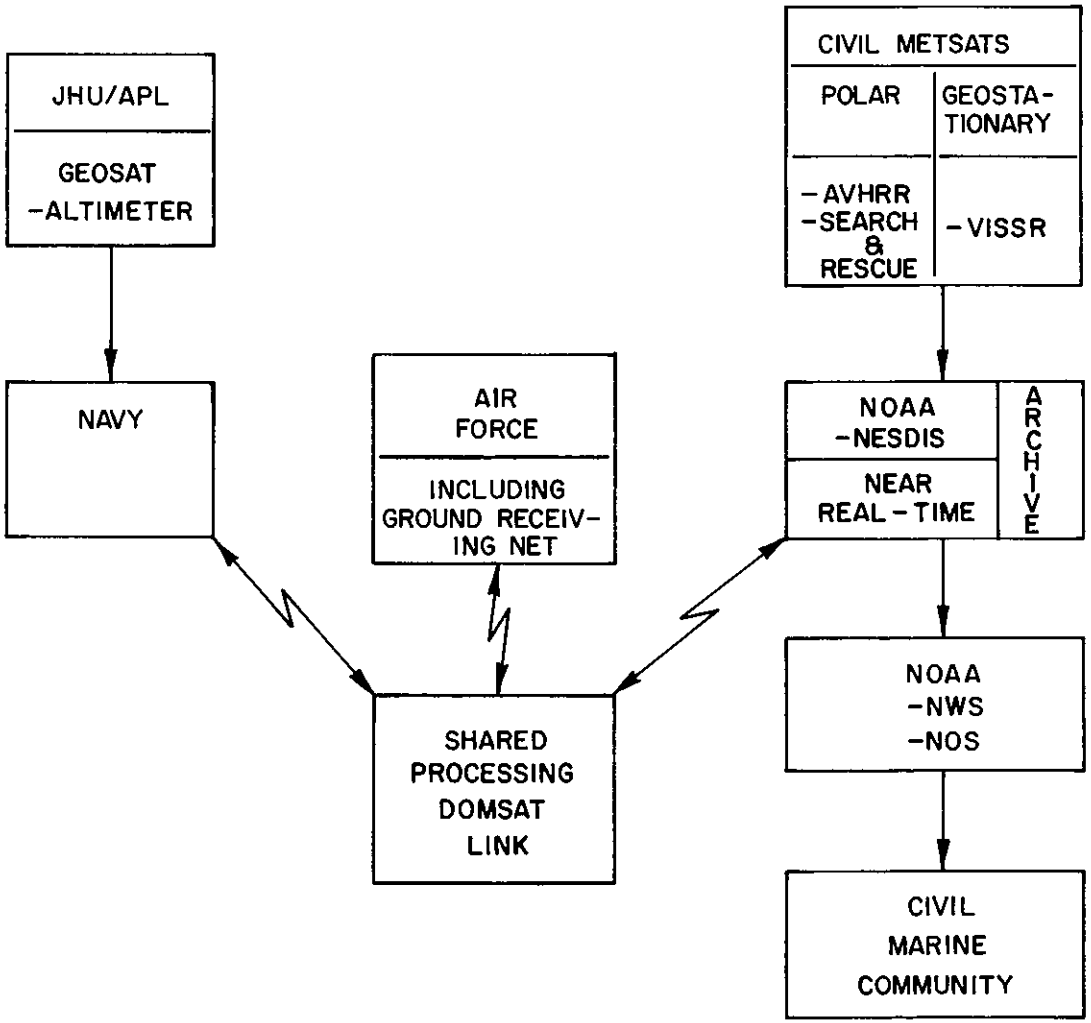
1985 OPERATIONAL SATELLITE OCEANIC INFORMATION DISTRIBUTION SYSTEM

- ALL CAPABILITY WILL BE MAINTAINED AS IN THE PRESENT (1984) DISTRIBUTION OF DATA.
- THE DOD/DMA GEOSAT ALTIMETER DATA WILL BE AVAILABLE TO NOAA AS THE SHARED PROCESSING SYSTEM IS IMPLEMENTED.
- GEOSAT WILL PROVIDE GEODETIC DATA AND GLOBAL OCEAN SURFACE WIND SPEED, SIGNIFICANT WAVE HEIGHT, AND ICE EDGE DATA (NADIR VIEW ONLY).
- THE SHARED PROCESSING PRODUCT RESPONSIBILITIES ARE IN GENERAL, DIVIDED AS FOLLOWS:

  - AIR FORCE - ALL SATELLITE IMAGERY
  - NAVY ------ ALL OCEAN DATA
  - NOAA------- ALL SOUNDING DATA

1985 OPERATIONAL SATELLITE OCEANIC INFORMATION DISTRIBUTION SYSTEM



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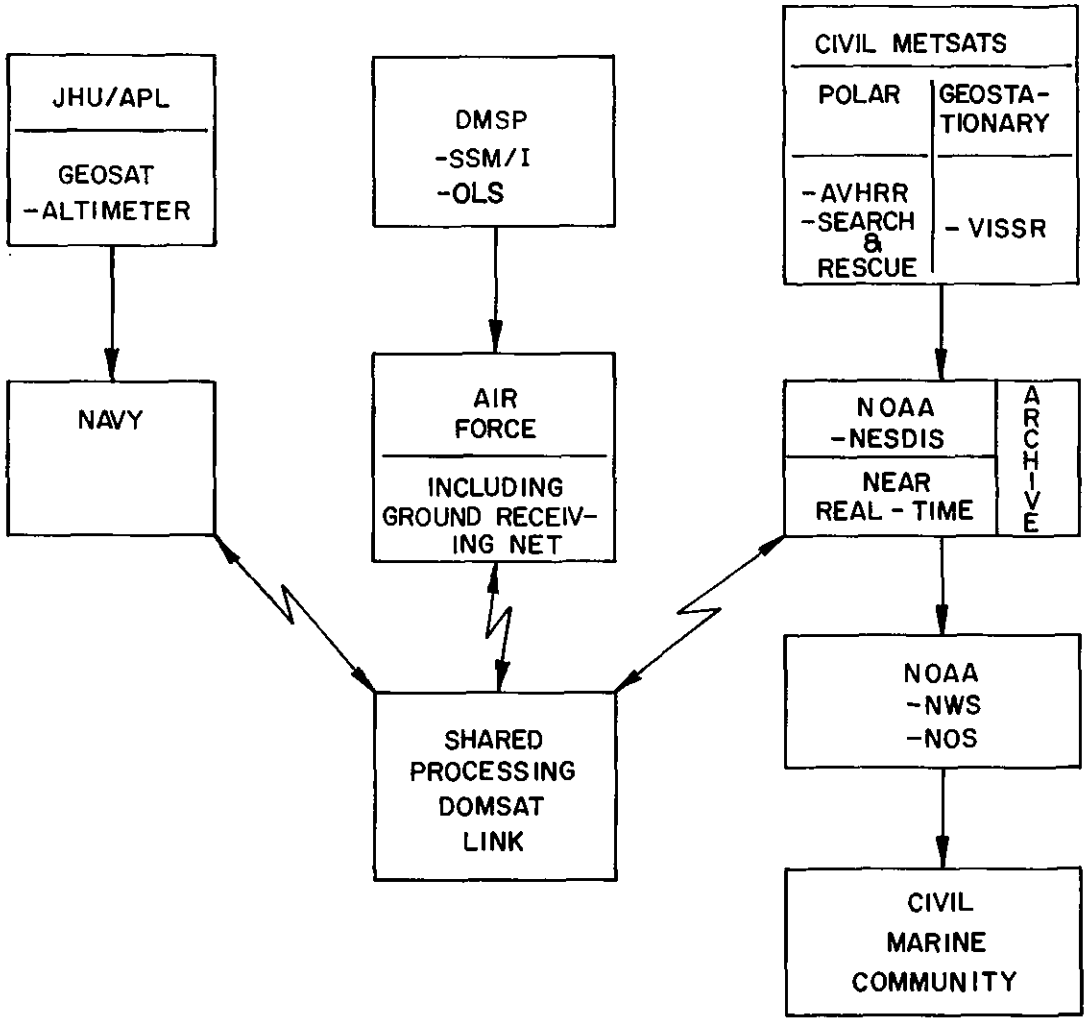
1986 OPERATIONAL SATELLITE OCEANIC INFORMATION DISTRIBUTION SYSTEM

- ALL CAPABILITY AS PLANNED FOR 1985.
- THE AIR FORCE DEFENSE METEOROLOGICAL SATELLITE PROGRAM (DMSP) SPECIAL SENSOR MICROWAVE IMAGER (SSM/I) WITH A 1394-Km SWATHWIDTH WILL ADD TO THE SHARED PROCESSING SYSTEM:

OCEAN SURFACE WINDSPEED	$\pm$2 m/s (3 to 25 m/s)
SEA ICE	
AREA COVERAGE	$\pm$12% (0 to 100%)
AGE	1ST YEAR OR MULTI-YEAR
EDGE LOCATION	$\pm$12.5KM
PRECIPITATION	$\pm$5MM/HR (0 to 25 MM/HR)
WATER VAPOR	$\pm$0.25 GM/CM^2
CLOUD WATER	$\pm$0.1 KG/M^2
LIQUID WATER	$\pm$2.0 KG/M^2 (0 to 6 KG/M^2)
SOIL MOISTURE	DRY-MOIST, WET-SATURATED
SNOW COVER	DRY OR MELTING

1986 OPERATIONAL SATELLITE OCEANIC INFORMATION DISTRIBUTION STSTEM



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1989-1990's OPERATIONAL SATELLITE OCEANIC INFORMATION DISTRIBUTION SYSTEM

- ALL CAPABILITY AS PLANNED FOR 1986, EXCEPT GEOSAT WILL BE TERMINATED (3 YEAR LIFE EXPECTED).

- THE NAVY REMOTE OCEAN SENSING SYSTEM (N-ROSS) SCHEDULED FOR JUNE, 1989, WILL BE ADDED TO THE SHARED PROCESSING SYSTEM. THE INSTRUMENTS ON N-ROSS WILL PROVIDE:

- ALTIMETER	- SAME DATA AS GEOSAT
- SSM/I	- SAME DATA AS DMSP-SSM/I
- SCATTEROMETER	- GLOBAL WIND VELOCITY ($\pm$ M/S and $\pm$20° OVER 3 to 30 M/S and 0 to 360°).
- LOW FREQUENCY MICROWAVE RADIOMETER	- ALL WEATHER SST TO 0.5°C AT 10-KM SPATIAL RESOLUTION (DESIRED).

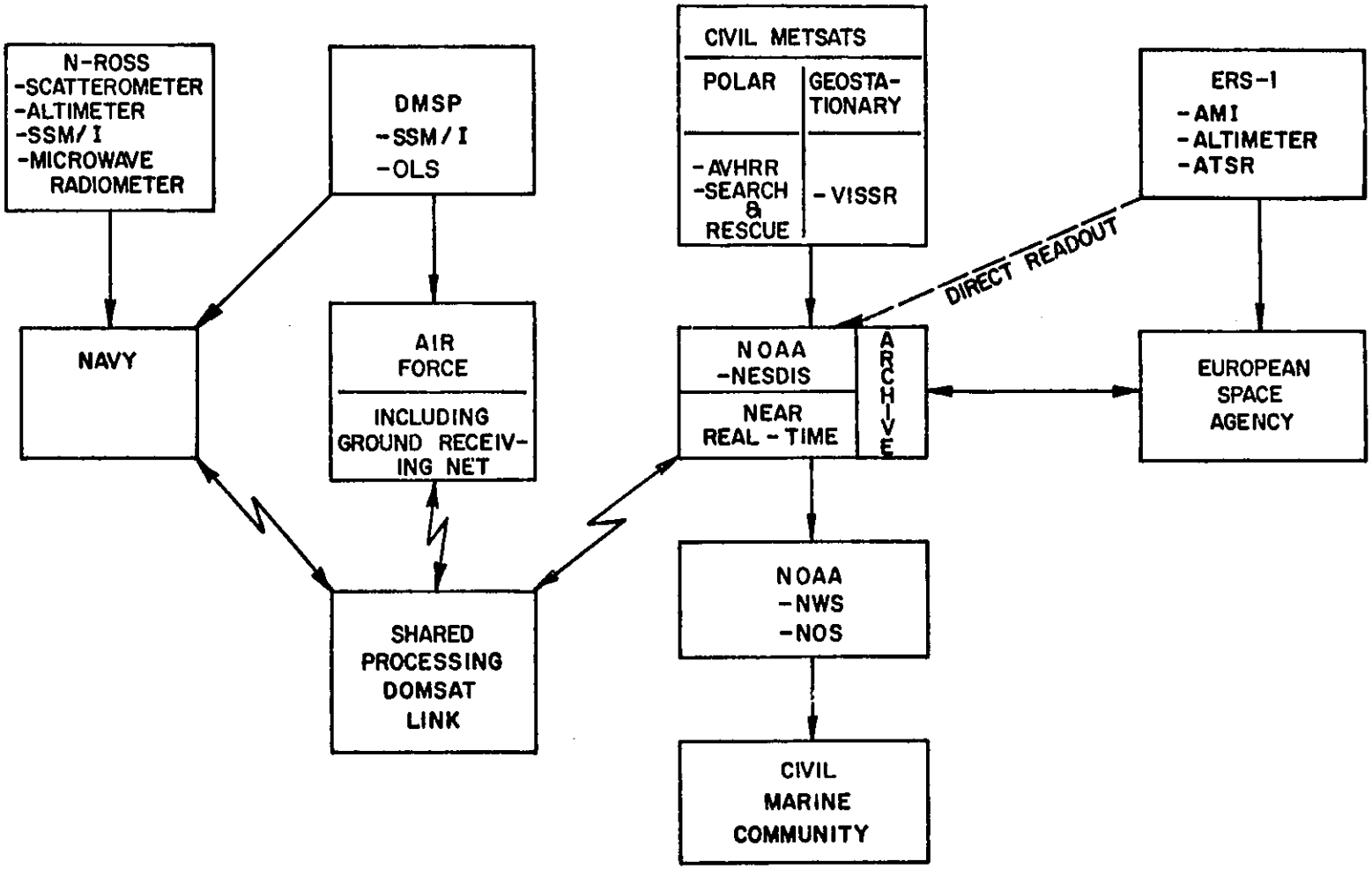
- THE EUROPEAN SPACE AGENCY (ESA) WILL LAUNCH ERS-1 IN 1989 AND WILL PROVIDE DATA SIMILAR TO N-ROSS WITH THESE EXCEPTIONS:

  - ERS-1 WILL FLY A SYNTHETIC APERTURE RADAR AS PART OF THE ACTIVE MICROWAVE INSTRUMENT (AMI)
  - THE ERS-1 ALONG-TRACK SCANNING RADIOMETER (ATSR) WILL PROVIDE 0.5° SST, BUT NOT ON AN ALL-WEATHER BASIS.

- NOAA ACCESS TO ERS-1 DATA DEPENDS ON NOAA ACCESS TO N-ROSS DATA.

- NAVY ACCESS TO ERS-1 DATA DEPENDS ON NOAA ACCESS TO ERS-1 DATA.

1989-1990's OPERATIONAL SATELLITE OCEANIC INFORMATION DISTRIBUTION SYSTEM



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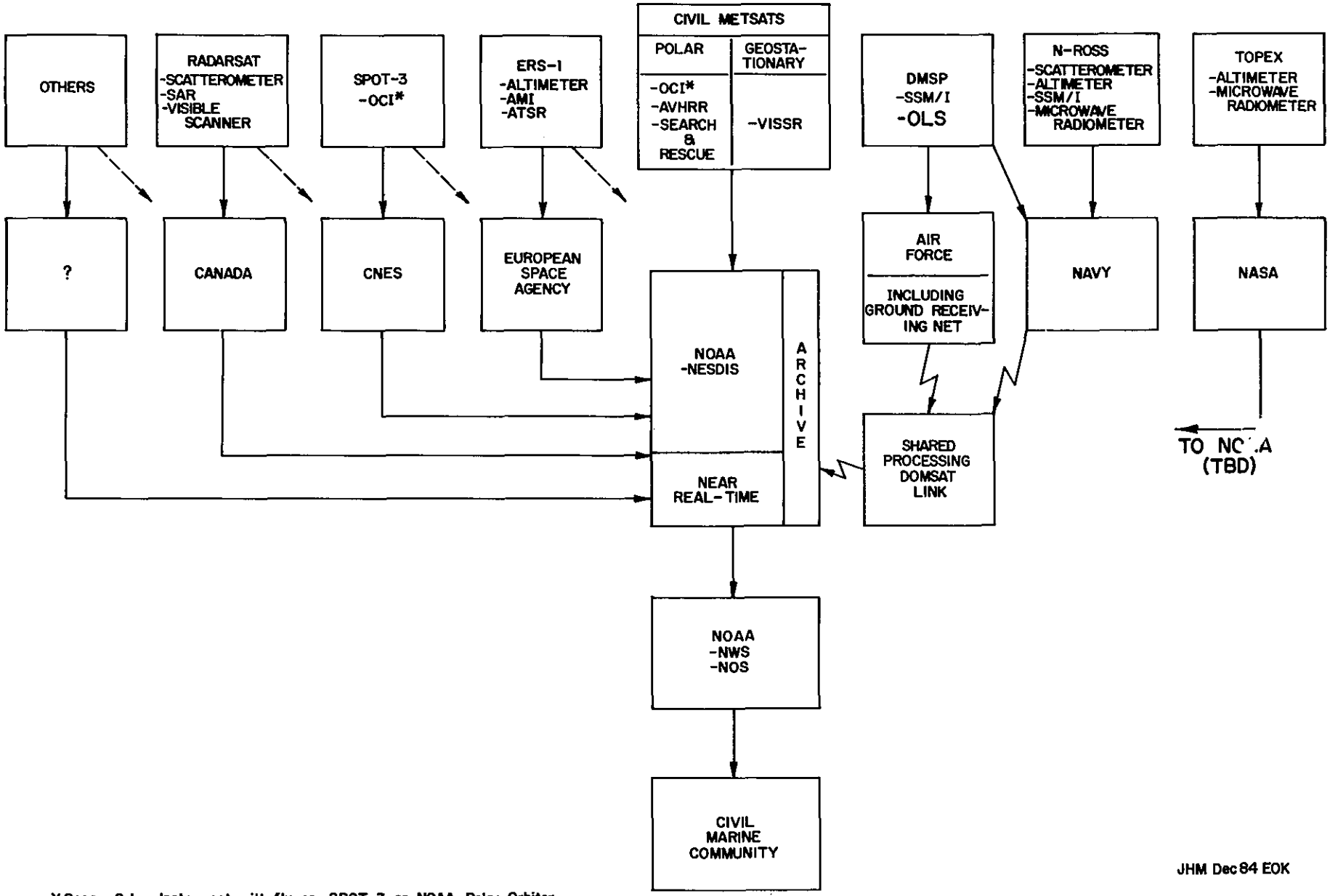
ALTERNATE 1990's OPERATIONAL SATELLITE OCEANIC INFORMATION/DISTRIBUTION SYSTEM

- ALL CAPABILITY AS PLANNED FOR 1989-1990, EXCEPT FOR TWO NEW PLANNED BUT UNFUNDED SYSTEMS.
- NASA PLANS A FY-1986 START FOR THE TOPOGRAPHY EXPERIMENT (TOPEX) WHICH WILL CARRY AN ALTIMETER WITH TWICE THE ACCURACY OF GEOSAT AND A MICROWAVE RADIOMETER SYSTEM FOR ATMOSPHERIC CORRECTIONS. THESE DATA FROM TOPEX CAN BE MADE AVAILABLE TO NOAA IN NEAR REAL-TIME AT VERY MODEST COSTS.
- NASA ALSO PLANS A JOINT OCEAN COLOR INSTRUMENT ON A COOPERATIVE BASIS WITH EITHER THE FRENCH SPACE AGENCY (CNES) OR NOAA (SEE KEY ISSUE DISCUSSION FOR AN OCEAN COLOR INSTRUMENT).
- IN ADDITION THE GOVERNMENTS OF CANADA AND JAPAN ARE PLANNING OCEANIC SATELLITE MISSIONS BUT ARE NOT AS YET INCLUDED AS A FORMAL PART OF THE NNEEDD ACTIVITY.

ALTERNATE 1990's OPERATIONAL SATELLITE OCEANIC INFORMATION DISTRIBUTION SYSTEM



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*Ocean Color Instrument will fly on SPOT-3 or NOAA Polar Orbiter.

——→ Direct Readouts to NOAA NESDIS.

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SUMMARY AND ANALYSES OF THE NNEEDD ACTIVITY

ANTICIPATED LEVELS OF OCEANIC DATA

- THE FOLLOWING TABLES PROVIDE THE APPROXIMATE LEVELS OF OCEANIC DATA TO BE DERIVED FROM THE PREVIOUSLY CITED SATELLITES FOR SEA SURFACE WINDS, TEMPERATURE, AND WAVES.

- WHILE THE DATA LEVELS BECOME LARGE BY THE 1989-90 TIME PERIOD, THE MANNER IN WHICH THE SATELLITES ARE PHASED PERMITS A LOGICAL GROWTH AND EXPERIENCE IN PROCESSING AND DISTRIBUTING THE DATA.

- IN ORDER TO UNDERSTAND THE POTENTIAL OCEANIC DATA ACQUISITION BY SATELLITES IT IS NOTED THAT THE SEASAT SCATTEROMETER COLLECTED MORE SEA SURFACE WIND DATA IN ITS 100-DAY LIFE THAN HAD BEEN COLLECTED FROM ALL OTHER SOURCES IN THE PREVIOUS 100 YEARS.

EARLY 1985 DATA LEVELS
(PER DAY)

- 2000-4000 SHIP AND BUOY WIND, TEMPERATURE, AND WAVE REPORTS.
- 30,000-70,000 AVHRR SEA SURFACE TEMPERATURE (SST) RETRIEVALS.

LATE 1985 ESTIMATED DATA LEVELS
(PER DAY)

- ALL DATA AS IN EARLY 1985.
- GEOSAT WILL ADD 60,000 SATELLITE-DERIVED WIND SPEED AND WAVE DATA POINTS.
- THE IN SITU SHIP AND BUOY DATA MUST BE MAINTAINED FOR VALIDATION AND QUALITY CONTROL OF SATELLITE DATA.

1986 ESTIMATED DATA LEVELS
(PER DAY)

- ALL DATA AS IN LATE 1985.
- THE DMSP SSM/I WILL ADD 968,000 SATELLITE-DERIVED WIND SPEED DATA POINTS.
- THE SSM/I WILL ADD ALL-WEATHER SEA ICE DATA AT 12.5-KM RESOLUTION.

1989-90 ESTIMATED DATA LEVELS
(PER DAY)

- ALL DATA AS IN 1986, EXCEPT THE GEOSAT 60,000 SATELITE-DERIVED WIND SPEED AND WAVE DATA POINTS.
- THE N-ROSS ALTIMETER WILL REPLACE THE GEOSAT 60,000 SATELLITE-DERIVED WIND SPEED AND WAVE DATA POINTS.
- THE N-ROSS SCATTEROMETER WILL ADD 825,000 SATELLITE-DERIVED WIND VELOCITY DATA POINTS.
- THE N-ROSS LFMR WILL ADD 600,000 SST RETRIEVALS IF THE SENSOR GOAL IS MET.
- THE ERS-1 ALTIMETER WILL ADD 60,000 SATELLITE-DERIVED WIND VELOCITY DATA POINTS.
- THE ERS-1 ATSR SST CAPABILITIES HAVE NOT BEEN ESTIMATED.

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ANTICIPATED LEVELS OF OCEANIC DATA

(SHIPS AND BUOYS, NOAA-SERIES, GEOSAT, DMSP, N-ROSS, ERS-1)

	DATA REPORTS PER DAY IN THOUSANDS					
	1984	1985	1986	1987	1988	1989
WINDS						
SPEED	2-4	60	1,000	2,000	2,000	4,000
DIRECTION	2-4	2-4	2-4	2-4	2-4	400-910
SEA SURFACE TEMPERATURE	30-70	30-70	30-70	30-70	30-70	650
WAVES	2-4	60	60	60	60	120

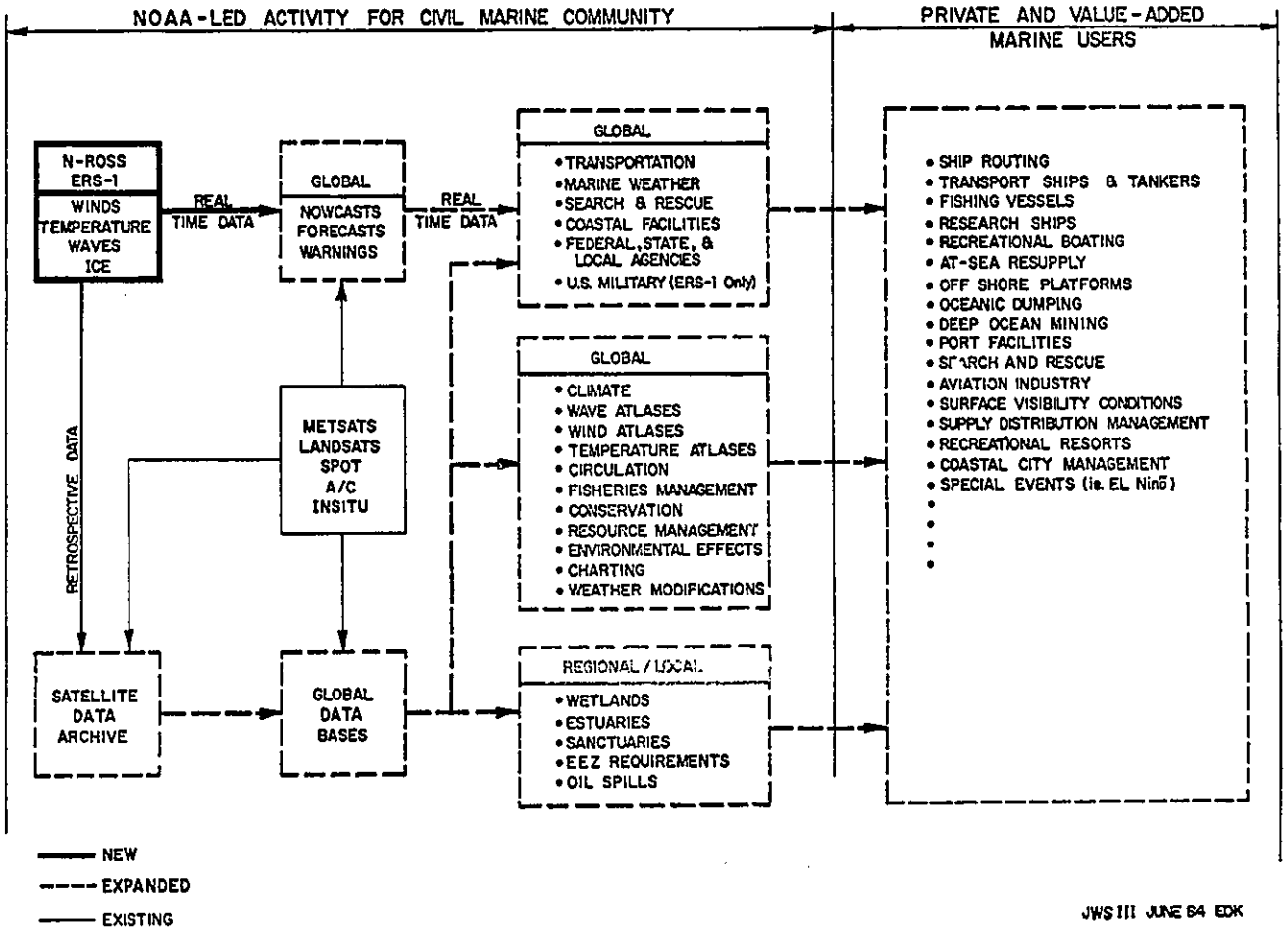
SUMMARY AND ANALYSES OF THE NNEEDD ACTIVITY

SATELLITE DATA USERS

- THE SATELLITE DATA USERS INCLUDE ALL SEGMENTS OF THE MARINE COMMUNITY, INCLUDING GOVERNMENTAL, ACADEMIC, AND COMMERCIAL OPERATORS.

- THESE OPERATORS REQUIRE HIGHLY VARIED PRODUCTS FOR GLOBAL, REGIONAL, AND LOCAL INFORMATION, WHICH CREATES AN OPPORTUNITY FOR VALUE-ADDED INDUSTRY.

- NOAA WILL PROVIDE LEVEL-II DATA (GEOPHYSICAL DATA LOCATED IN TIME AND PLACE) IN NEAR REAL-TIME AND RETROSPECTIVELY (ARCHIVE).


NOAA-LED ACTIVITY FOR CIVIL MARINE COMMUNITY
PRIVATE AND VALUE-ADDED MARINE USERS
N-ROSS
ERS-1
WINDS
TEMPERATURE
WAVES
ICE
REAL TIME DATA
GLOBAL
NOWCASTS
FORECASTS
WARNINGS
REAL TIME DATA
GLOBAL
• TRANSPORTATION
• MARINE WEATHER
• SEARCH & RESCUE
• COASTAL FACILITIES
• FEDERAL, STATE, & LOCAL AGENCIES
• U.S. MILITARY (ERS-1 Only)
GLOBAL
• CLIMATE
• WAVE ATLASES
• WIND ATLASES
• TEMPERATURE ATLASES
• CIRCULATION
• FISHERIES MANAGEMENT
• CONSERVATION
• RESOURCE MANAGEMENT
• ENVIRONMENTAL EFFECTS
• CHARTING
• WEATHER MODIFICATIONS
REGIONAL / LOCAL
• WETLANDS
• ESTUARIES
• SANCTUARIES
• EEZ REQUIREMENTS
• OIL SPILLS
• SHIP ROUTING
• TRANSPORT SHIPS & TANKERS
• FISHING VESSELS
• RESEARCH SHIPS
• RECREATIONAL BOATING
• AT-SEA RESUPPLY
• OFF SHORE PLATFORMS
• OCEANIC DUMPING
• DEEP OCEAN MINING
• PORT FACILITIES
• SEARCH AND RESCUE
• AVIATION INDUSTRY
• SURFACE VISIBILITY CONDITIONS
• SUPPLY DISTRIBUTION MANAGEMENT
• RECREATIONAL RESORTS
• COASTAL CITY MANAGEMENT
• SPECIAL EVENTS (ie. EL Niño)
METSATS
LANDSATS
SPOT
A/C
INSITU
RETROSPECTIVE DATA
SATELLITE DATA ARCHIVE
GLOBAL DATA BASES
NEW
EXPANDED
EXISTING
JWS III JUNE 84 EDK

SUMMARY AND ANALYSES OF THE NNEEDD ACTIVITY

NOAA ROLE AND INTERFACES

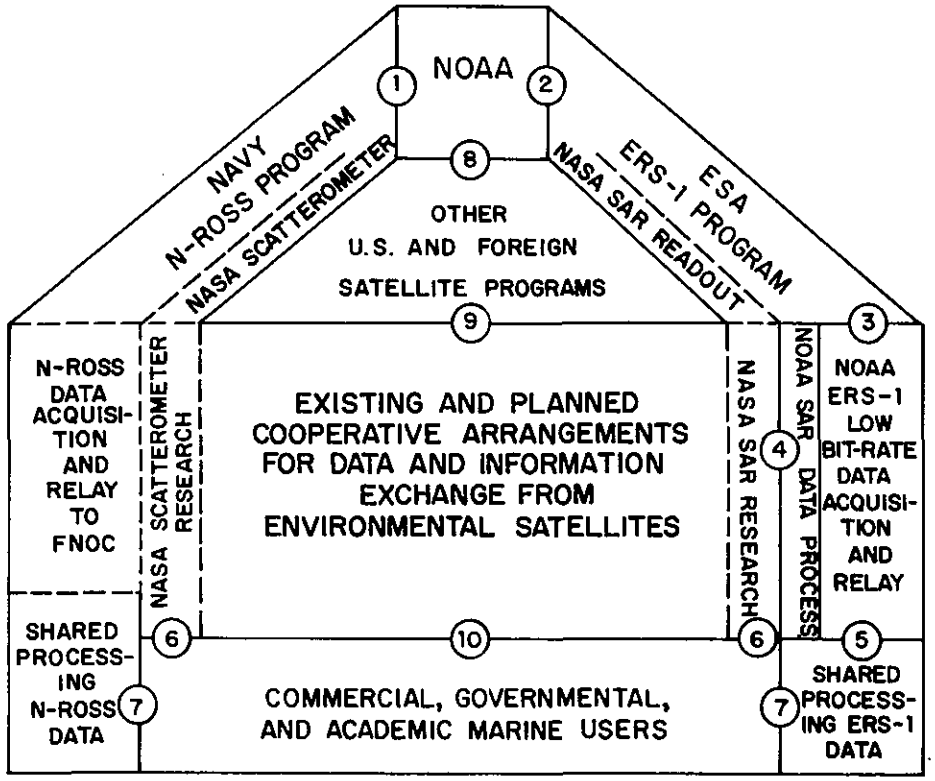
- NOAA WILL SERVE THE CIVIL SECTOR AS THE CATALYST FOR PROVIDING ACCESS TO A NUMBER OF OCEANIC SATELLITE SENSORS.

- AS A CATALYST, THE RESOURCES REQUIRED BY NOAA ARE MODEST COMPARED TO THE SATELLITE HARDWARE COST.

- BECAUSE NOAA IS NOT DEVELOPING THE SATELLITE HARDWARE, A NUMBER OF INTERFACES FOR PROGRAM MANAGEMENT AND ADMINISTRATION ARE REQUIRED.

- THESE NOAA INTERFACES ARE:

  1. N-ROSS (MOA IN PROGRESS)
  2. ERS-1 (MOA TO BE INITIATED IN LATE 1984)
  3. NOAA PROPOSES TO RECEIVE ERS-1 LOW BIT-RATE DATA AT GILMORE CREEK
  4. NOAA PROPOSES TO OBTAIN NASA ACQUIRED SAR DATA FOR SEA ICE OPERATIONS
  5. ERS-1 OPERATIONAL LOW-BIT RATE DATA WILL BE TRANSFERRED BY NOAA TO THE DOMSAT SHARED PROCESSING LINK
  6. ALL ARCHIVING FOR NASA RESEARCH ACTIVITIES WILL BE ACCOMPLISHED BY NOAA FOR GENERAL MARINE COMMUNITY ACCESS
  7. LEVEL-II DATA WILL RESIDE IN THE SHARED PROCESSING SYSTEM THROUGH NOAA PARTICIPATION
  8. OTHER SATELLITE DATA ACCESS, SUCH AS DMSP (SSM/I), WILL BE INTEGRATED INTO LEVEL-II PRODUCTS
  9. NUMEROUS NATIONAL PROGRAMS AND INTERNATIONAL EXPERIMENTS, SUCH AS THE WORLD OCEAN CIRCULATION EXPERIMENT. ARE DEPENDENT ON THIS INITIATIVE
  10. DIRECT COMMITMENTS MUST BE MADE BY GOVERNMENT AND INDUSTRY ALIKE BEGINNING IN FY-1986 IF THE PLANNED APPLICATIONS AND SERVICES ARE TO BE IN PLACE BY 1989.



NOAA Management and Administrative Requirements For N-ROSS and ERS-1 Interface Functions To Support Marine Applications and Operations.

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SUMMARY AND ANALYSES OF THE NNEEDD ACTIVITY

FUNDING REQUIREMENTS

- THE FUNDING REQUIREMENTS ALLOW ACCESS TO MORE THAN $1 BILLION OF SATELLITE HARDWARE.

- FUNDING LEVEL DETAILS ARE PROVIDED IN A COMPANION DOCUMENT ENTITLED "OCEANIC OBSERVING SERVICES SYSTEM FY-87 INITIATIVE".

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SUMMARY AND ANALYSES OF THE NNEEDD ACTIVITY

EXAMPLES OF SATELLITE-DERIVED NEAR REAL-TIME OCEANIC DATA

- NASA HAS PREPARED AN EXEMPLARY SET OF OCEANIC APPLICATIONS FROM SPACE.
- THE JOINT OCEANOGRAPHIC INSTITUTIONS (JOI) INCORPORATED HAS PREPARED SCIENTIFIC JUSTIFICATION FOR SATELLITE DERIVED OCEANOGRAPHIC DATA.
- THE CRITICAL NOAA AND CIVIL MARINE PRIORITIES FOR SATELLITE DATA ARE SURFACE WINDS, TEMPERATURE, WAVES, SEA ICE, OCEAN COLOR, AND CIRCULATION.
- THE OPERATIONAL USE OF THESE DATA TYPES ARE SHOWN IN THE FOLLOWING PAGES AS EXAMPLES OF DATA PRODUCTS AND SERVICES TO BE DERIVED FROM THE NNEEDD ACTIVITY.
- VALUE-ADDED INDUSTRY WILL PLAY A MAJOR ROLE IN THESE PRODUCTS AND SERVICES IF AN OPERATIONAL COMMITTMENT IS MADE TO THE NNEEDD APPROACH FOR CIVIL MARINE COMMUNITY INVOLVEMENT IN NON-NOAA OCEANIC SATELLITES.

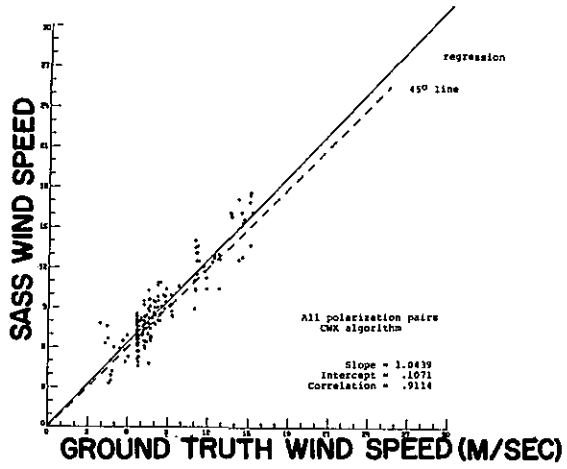
EXAMPLES OF SATELLITE-DERIVED NEAR REAL-TIME OCEANIC DATA, INFORMATION, AND SERVICES

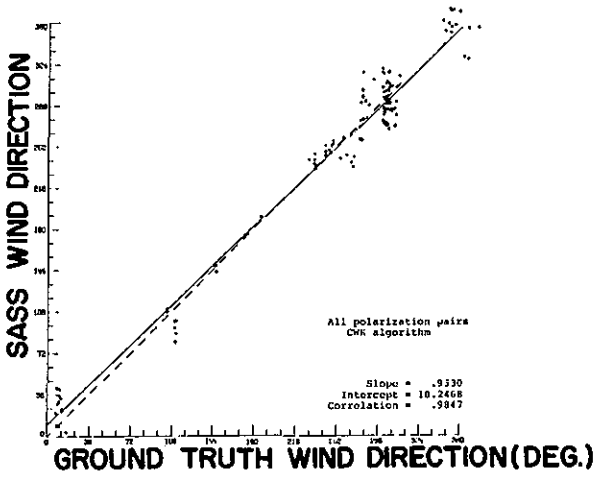
WINDS

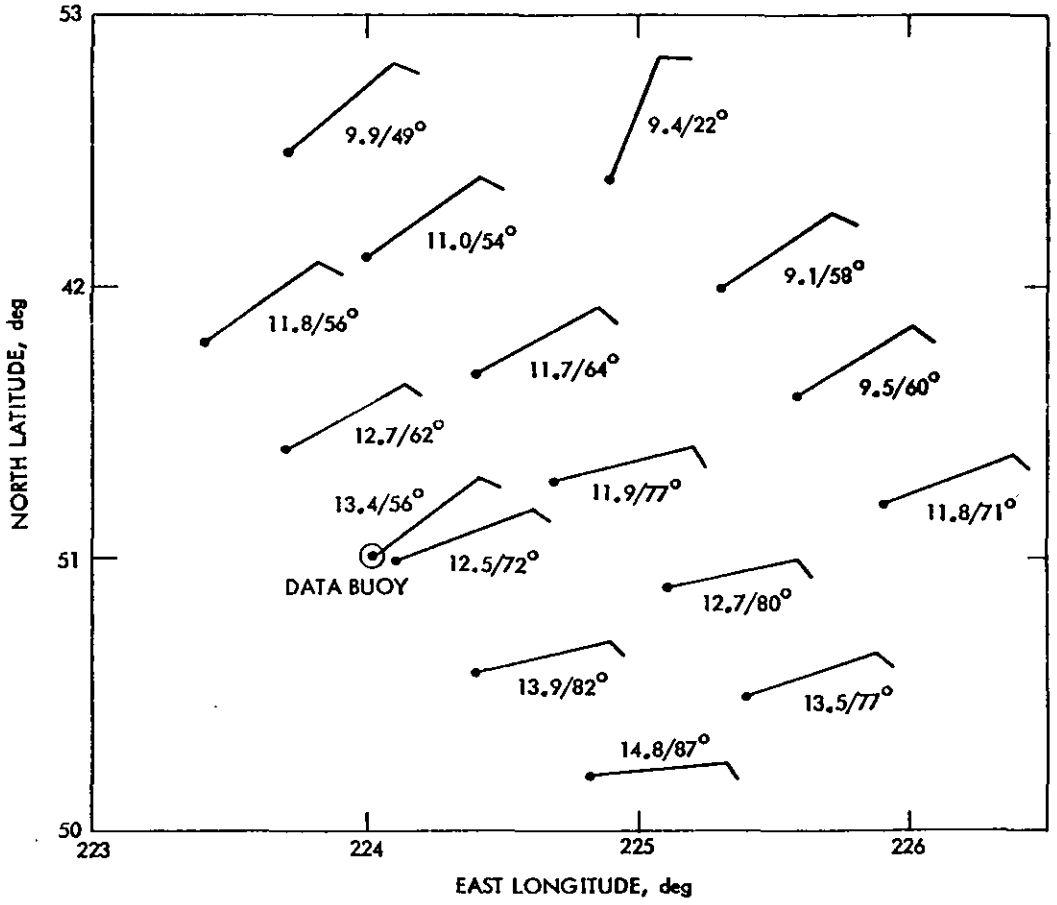
OCEAN SURFACE WIND VECTORS FROM SATELLITE SCATTEROMETRY

- SATELLITE DERIVED WINDS FROM SEASAT ARE SHOWN COMPARED WITH NOAA BUOYS FOR A RANGE OF WIND SPEEDS AND DIRECTIONS.
- INTERCOMPARISONS SHOW ACCURACY OF SATELLITE-DERIVED WINDS TO BE $\pm$ 2m/sec OR 10% IN SPEED AND $\pm$ 20° IN DIRECTION (1σ) UNDER OPTIMAL CONDITIONS.
- SCATTEROMETER HAS ALSO PROVED ABILITY TO LOCATE FRONTS ACCURATELY.
- FURTHER REFINEMENTS IN ALGORITHM ARE NEEDED TO ACCOUNT FOR AFFECTS DUE TO UNSTEADY, HIGHLY VARIABLE WIND FIELDS.

SEASAT SASS VERSUS SHIP REPORTS







The SASS Wind Field in the Vicinity of Data Buoy 4 for Rev 1298 (Vertical Polarization)

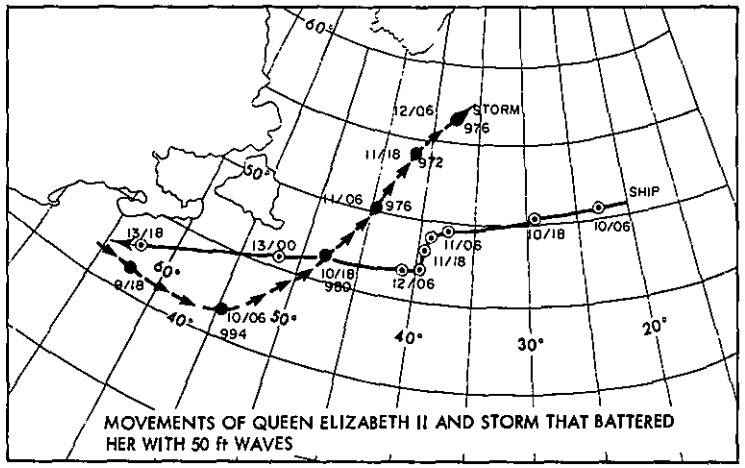
EXAMPLES OF SATELLITE-DERIVED NEAR REAL-TIME OCEANIC DATA, INFORMATION, AND SERVICES

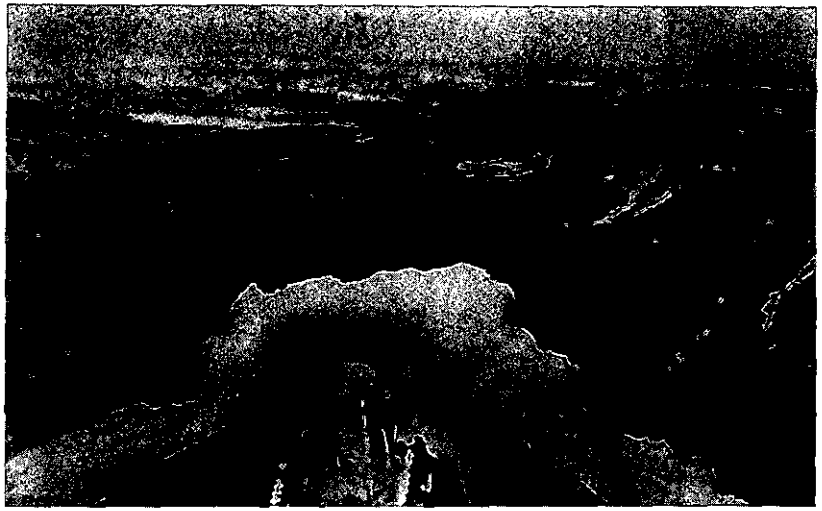
WINDS

SEVERE STORMS MONITORING WITH SATELLITE SCATTEROMETER

- SCATTEROMETER-DERIVED WINDS FROM SEASAT ARE SHOWN SUPERIMPOSED ON A NOAA-5 IMAGE OF NORTH ATLANTIC STORM THAT CAUSED DAMAGE TO THE LUXURY LINER QUEEN ELIZABETH II ON SEPTEMBER 11, 1978.
- WEATHER FORECASTS UNDERESTIMATED THE WIND BY A FACTOR OF TWO, RESULTING IN A FACTOR OF FOUR ERROR IN THE WAVE FORECASTS. SEAS FORECAST AS 9FT. WERE CLOSER TO 35FT.
- GLOBAL OCEAN SCATTEROMETER-DERIVED WINDS FROM N-ROSS, ERS-1 WILL PROVIDE ACCURATE GLOBAL WINDS FOR IMPROVED FORECASTS OF STORMS.

NORTH ATLANTIC STORM





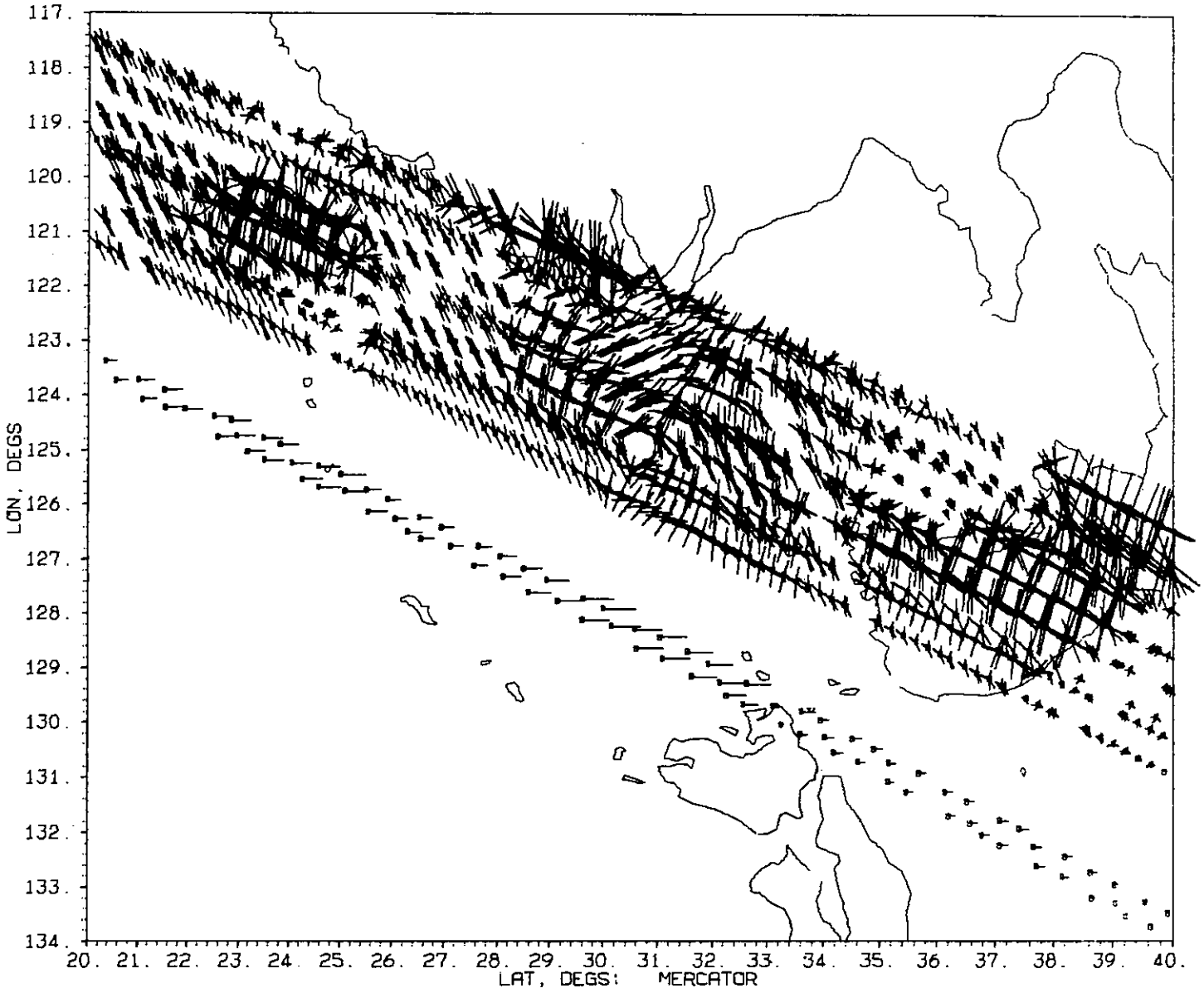
EXAMPLES OF SATELLITE-DERIVED NEAR REAL-TIME OCEANIC DATA, INFORMATION, AND SERVICES

WINDS

SEVERE STORM MONITORING WITH SATELLITE SCATTEROMETER

- TYPHOON WENDY IS SHOWN IN SEASAT SCATTEROMETER COVERAGE OVER THE SOUTH CHINA SEA JULY 30, 1978.
- THIS ILLUSTRATION SHOWS ALL POSSIBLE WIND VECTOR SOLUTIONS (UP TO FOUR) WITH VECTOR LENGTH BEING PROPORTIONAL TO WIND MAGNITUDE AND DIRECTION GIVEN BY VECTOR DIRECTION.
- THE STORM CENTER AND AREA OF HIGHEST WINDS ARE CLEARLY DEPICTED.
- THIS PRODUCT IS REPRESENTATIVE OF SURFACE WIND PRODUCTS ACHIEVABLE FROM N-ROSS, ERS-1 SCATTEROMETERS.

TYPHOON WENDY OVER THE SOUTH CHINA SEA



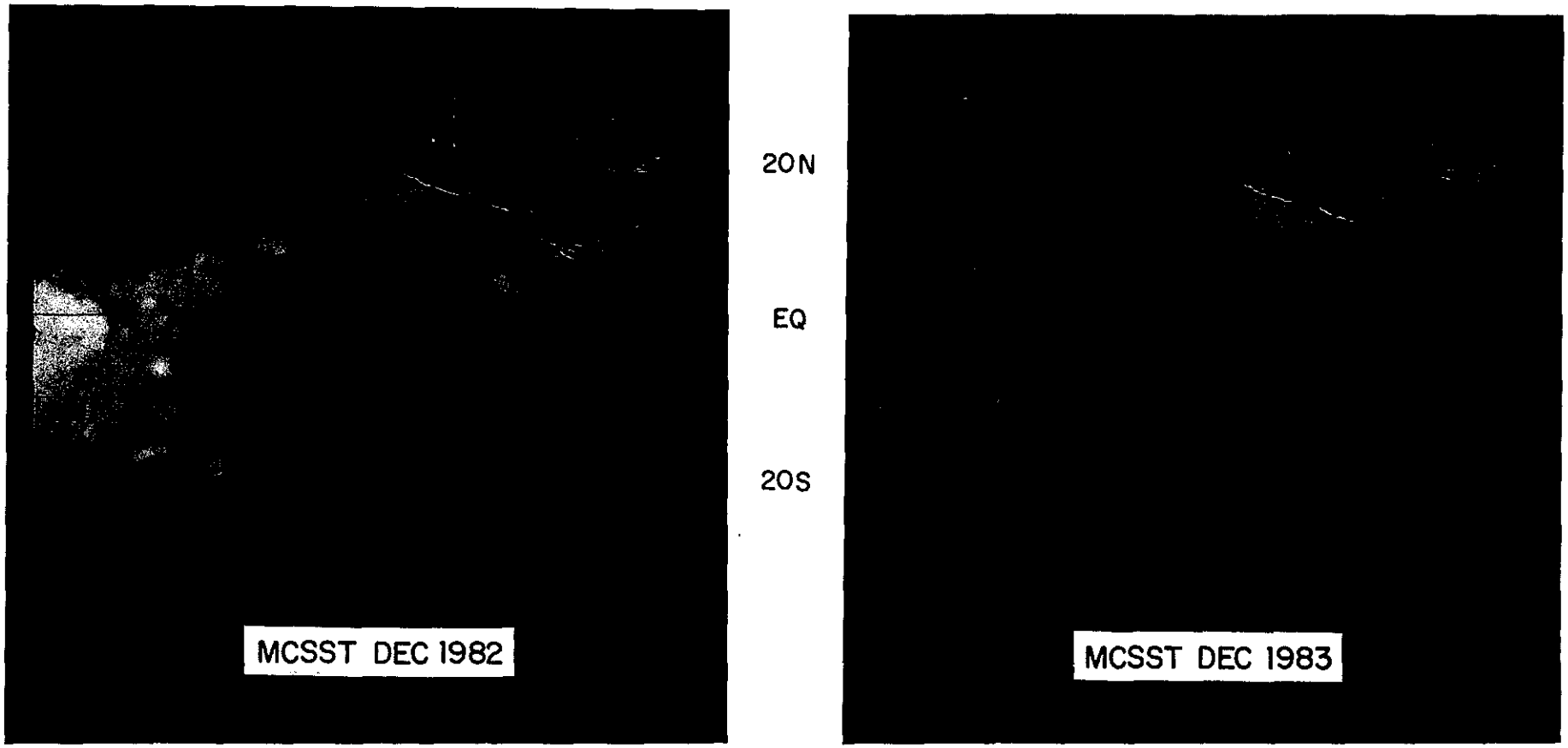
EXAMPLES OF SATELLITE-DERIVED NEAR REAL-TIME OCEANIC DATA INFORMATION, AND SERVICES

SEA SURFACE TEMPERATURES

MONITORING EL NINO

- THE NOAA-7 INFRARED MEASUREMENTS MONITOR SEA SURFACE TEMPERATURES (SST) IN THE EQUATORIAL PACIFIC OCEAN.
- WEEKLY 50-KMS AVERAGE SST ARE PREPARED AS PART OF THE EQUATORIAL PACIFIC OCEAN CLIMATE STUDY (EPOCS)
- LARGE INTERANNUAL SST VARIATIONS DETECTED IN THE EQUATORIAL PACIFIC DURING 1982 and 1983.
- DURING DECEMBER 1982, WARM WATER DOMINATED THE EQUATORIAL PACIFIC AS A RESULT OF THE EL NINO EVENT (DARK = COLD: LIGHT-WARM).
- DURING DECEMBER 1983, NORMAL SST (COLD WATER ALONG THE EQUATOR) IS EVIDENT IN THE IMAGE .

Mean 7-Day SST — EQUATORIAL PACIFIC



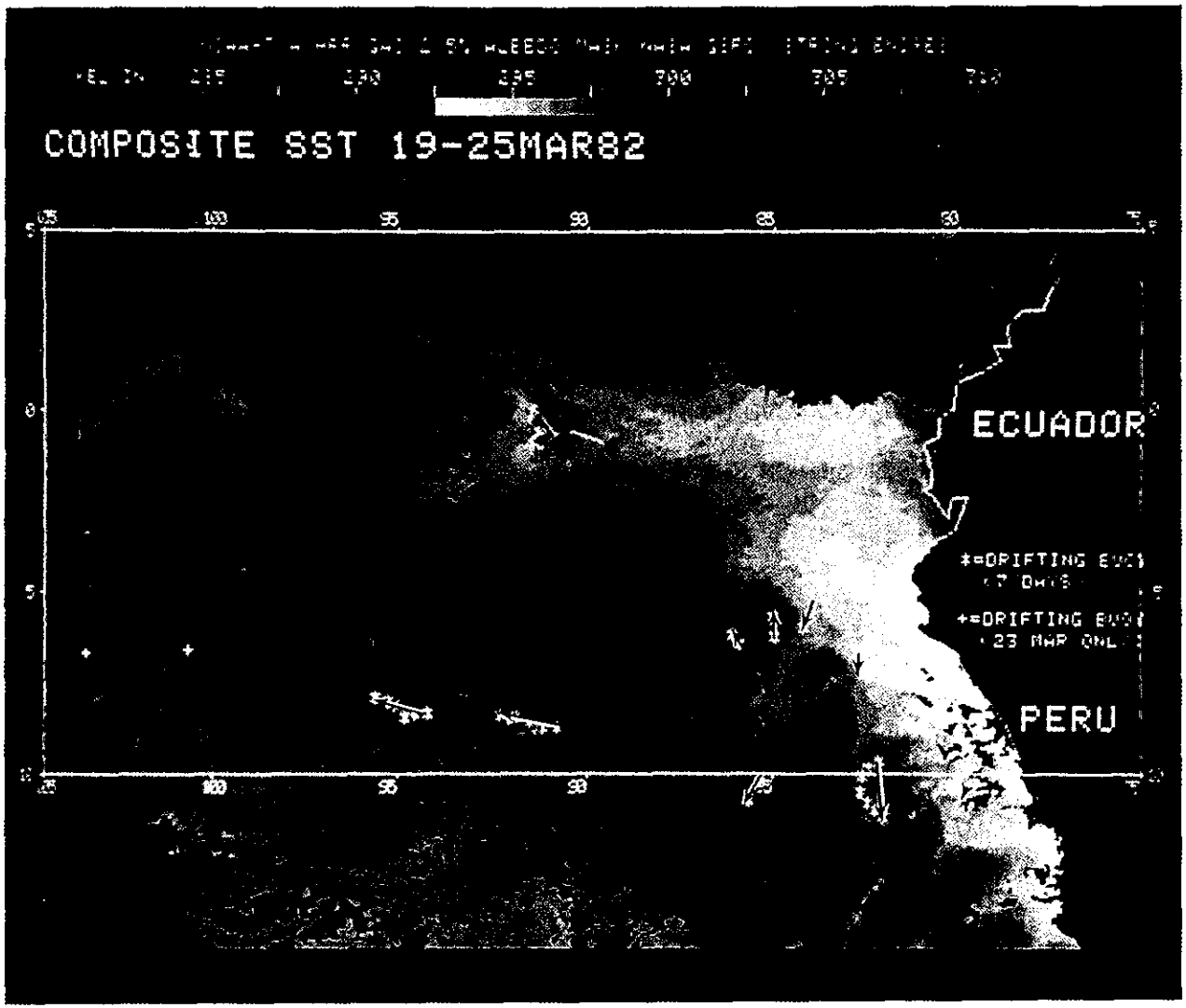
EXAMPLES OF SATELLITE-DERIVED NEAR REAL-TIME OCEANIC DATA, INFORMATION, AND SERVICES

SEA SURFACE TEMPERATURES

SEA SURFACE TEMPERATURES WITH ADVANCED VERY HIGH RESOLUTION RADIOMETER (AVHRR)

- OPERATIONAL MULTICHANNEL SST (MCSST) DERIVATION.
- 7 DAY COMPOSITE OF 4KM AVHRR DATA-RETAINS HIGHEST VALUE DURING PERIOD.
- COMPOSITE FILTERS MOST CLOUDS (BLACK AREAS OVER OCEANS).
- COOL UPWELLING PERU CURRENT MOVING WESTWARD FROM PERU-ECUADOR COAST ALONG THE EQUATOR.
- DRIFTING BUOYS USED TO VALIDATE MCSSTs SHOWN BY ARROWS.
- DRIFTERS LOCATED BY FRENCH SERVICE ARGOS THROUGH NOAA SATELLITES.
- BUOY DATA COLLECTED AND MADE AVAILABLE ON GLOBAL TELECOMMUNICATION SYSTEM (GTS) BY SERVICE ARGOS IN NEAR REAL-TIME.

COMPOSITE SST DERIVATIONS ALONG THE EQUATOR

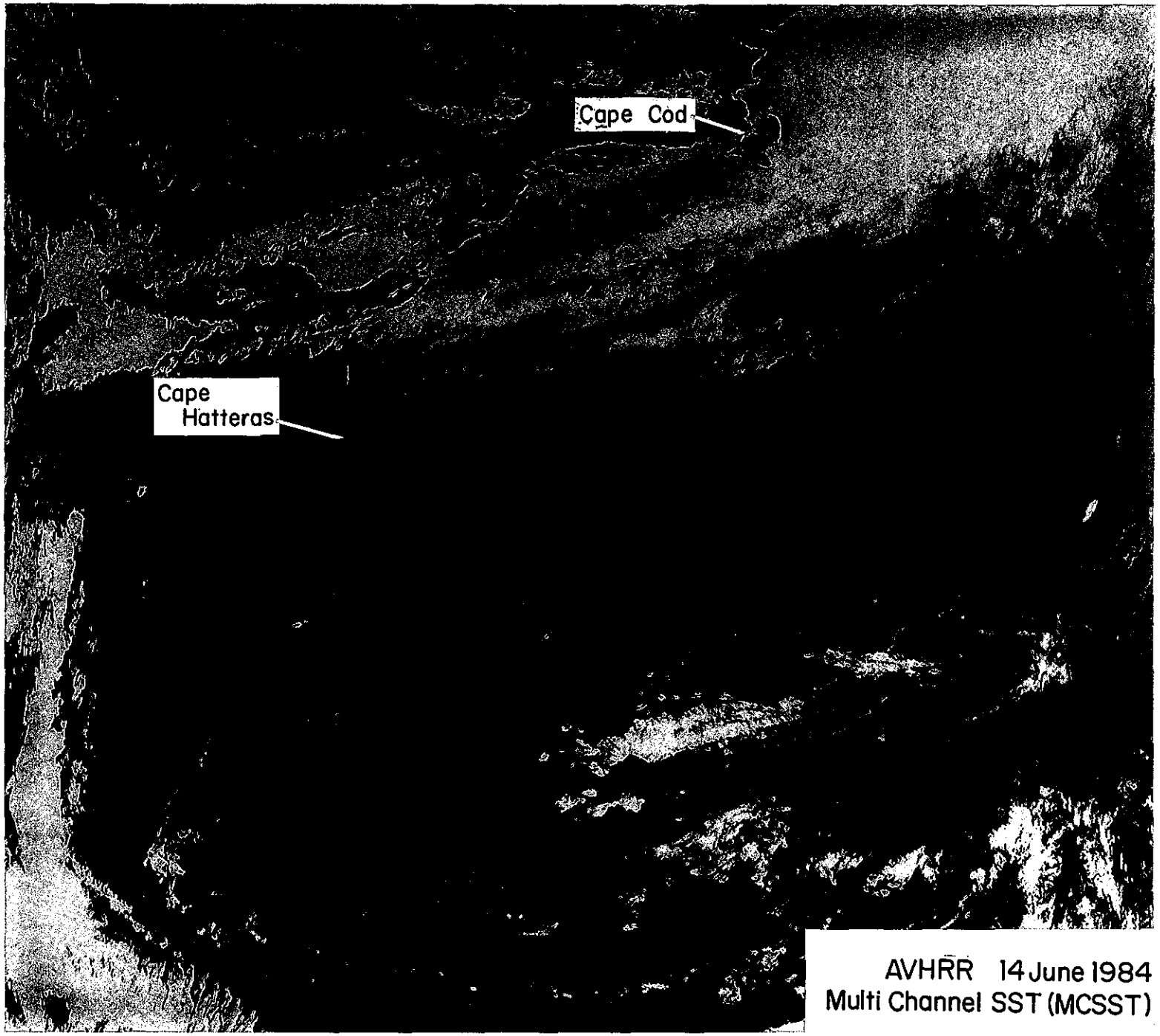


EXAMPLES OF SATELLITE-DERIVED NEAR REAL-TIME OCEANIC DATA, INFORMATION, AND SERVICES

SEA SURFACE TEMPERATURES

SEA SURFACE TEMPERATURES WITH THE ADVANCED VERY HIGH RESOLUTION RADIOMETER (AVHRR)

- OPERATIONAL MULTICHANNEL SST (MCSST) PROCESSED DATA
- 1-KM RESOLUTION DATA
- CORRECTED FOR ATMOSPHERIC WATER VAPOR
- GULF STREAM MEANDERINGS FROM FLORIDA INTO THE NORTH ATLANTIC
- SMOOTH GULF STREAM FLOW BREAKS DOWN SOUTH OF CAPE COD INTO LARGE MEANDERS AND FILAMENTS
- MUCH SUPERIOR DETAIL THAN SEEN FROM SINGLE CHANNEL IMAGES.
- JUNE 14, 1984 - NOAA-7



AVHRR 14 June 1984
Multi Channel SST (MCSST)

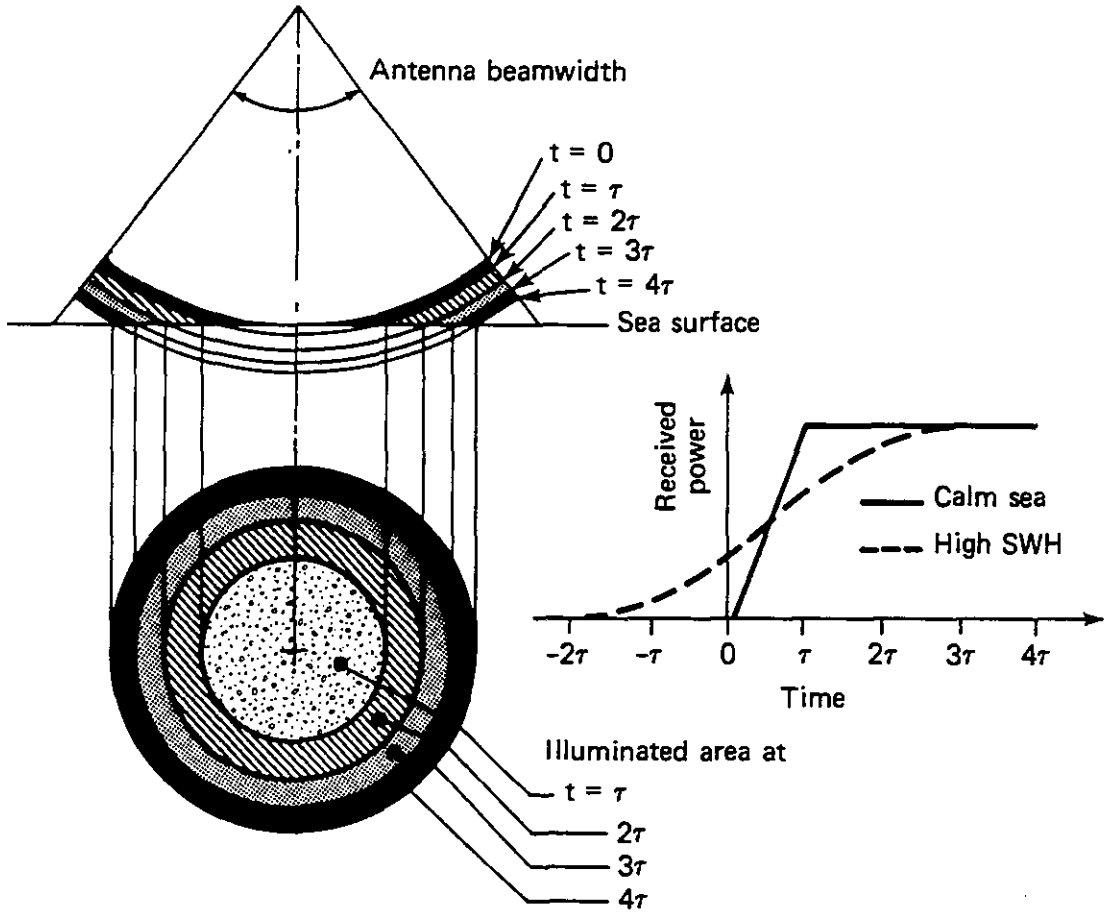
EXAMPLES OF SATELLITE-DERIVED NEAR REAL-TIME OCEANIC DATA, INFORMATION, AND SERVICES

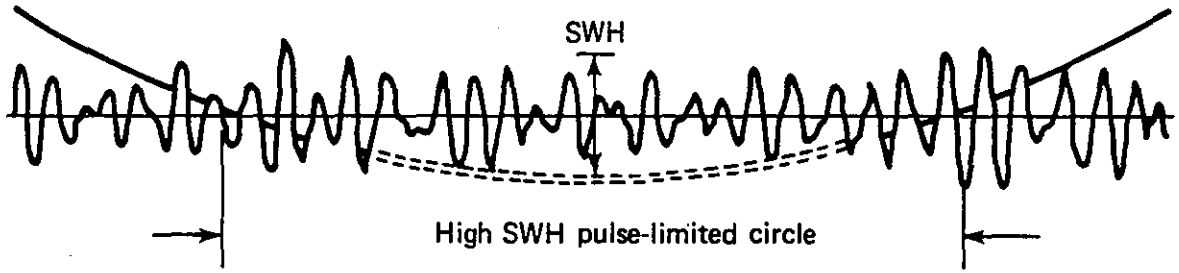
WAVES

ALTIMETER GEOMETRY FOR MEASUREMENT OF WAVES

- OCEAN WAVE CRESTS AND TROUGHS REFLECT TRANSMITTED RADAR PULSES FROM GEOSAT/N-ROSS ALTIMETERS BACK TO THE SATELLITES.
- SIGNIFICANT WAVE HEIGHT (SWH), THE AVERAGE HEIGHT OF THE ONE-THIRD HIGHEST WAVES. IS PROPORTIONAL TO THE SLOPE OF THE LEADING EDGE OF THE REFLECTED RADAR WAVE FORM.
- CALM SEA RESULTS IN STEEP RETURN SLOPE OF RADAR WAVE FORM.
- AS SWH INCREASES, RETURN SLOPE BECOMES LESS STEEP. ILLUMINATED AREA = 2.4KM FOR CALM SEA INCREASING TO 11.6KM FOR SWH = 20M.

ALTIMETER GEOMETRY FOR MEASUREMENT OF WAVES





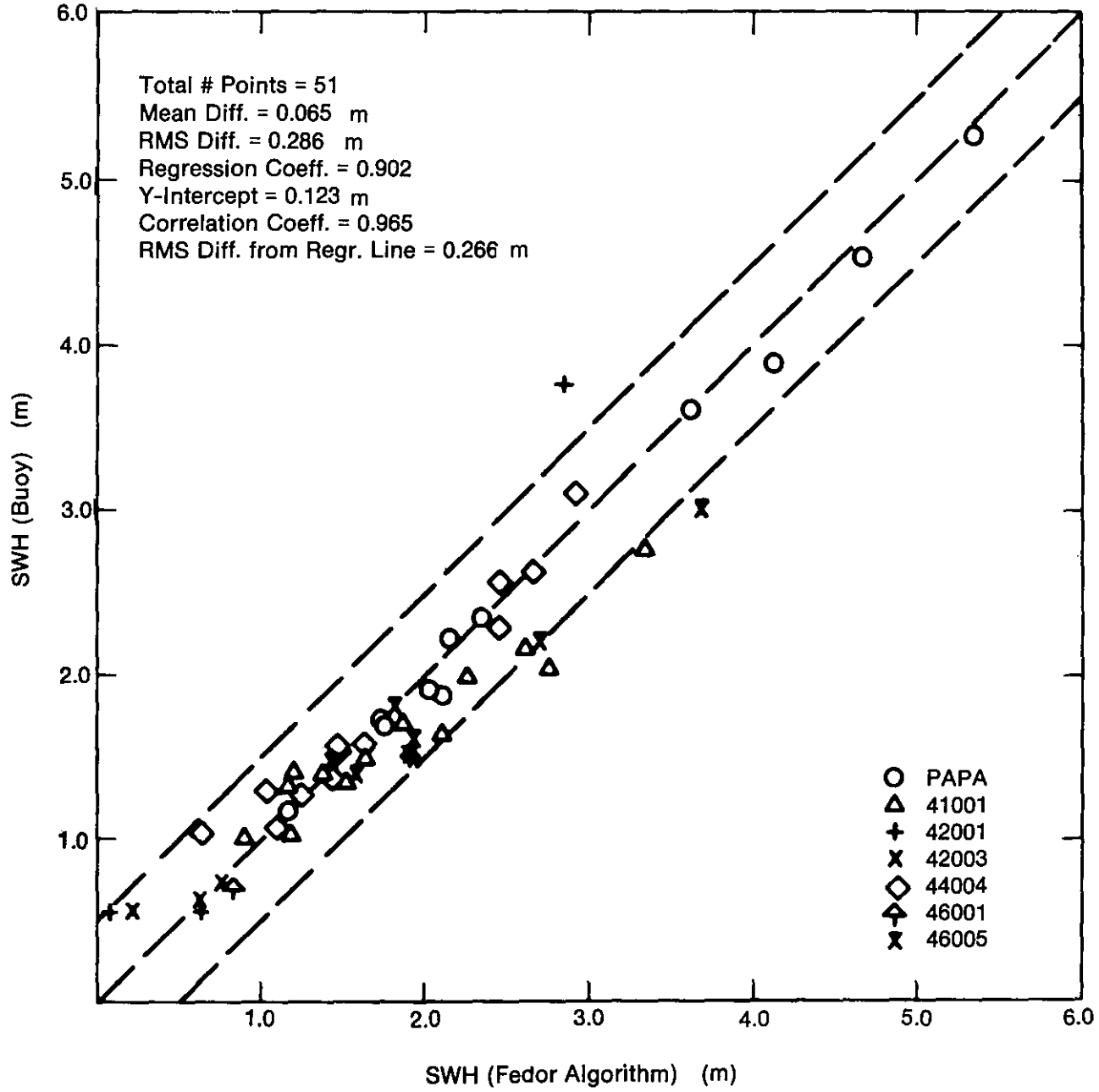
EXAMPLES OF SATELLITE-DERIVED NEAR REAL-TIME OCEANIC DATA, INFORMATION, AND SERVICES

WAVES

ALTIMETER MEASUREMENT OF WAVES

- COMPARISON OF SEASAT ALTIMETER SIGNIFICANT WAVE HEIGHT (SWH) TO SWH MEASURED FROM OCEAN WEATHER STATION PAPA AND NOAA DATA BUOYS ILLUSTRATES SUCCESSFUL USE OF RADAR ALTIMETER FOR OPEN OCEAN WAVE MEASUREMENTS.
- FIRST GLOBAL MAP OF OCEAN WAVE HEIGHT FROM SEASAT ILLUSTRATES NEW PRODUCTS FROM GEOSAT/N-ROSS.
- GEOSAT/N-ROSS ALTIMETERS OF SIMILAR DESIGN WILL PROVIDE SWH TO ACCURACIES OF 10% OF SWH OR 0.5 METER, WHICHEVER IS GREATER.

SEASAT ALTIMETER WAVES VERSUS SHIP AND BUOY WAVES



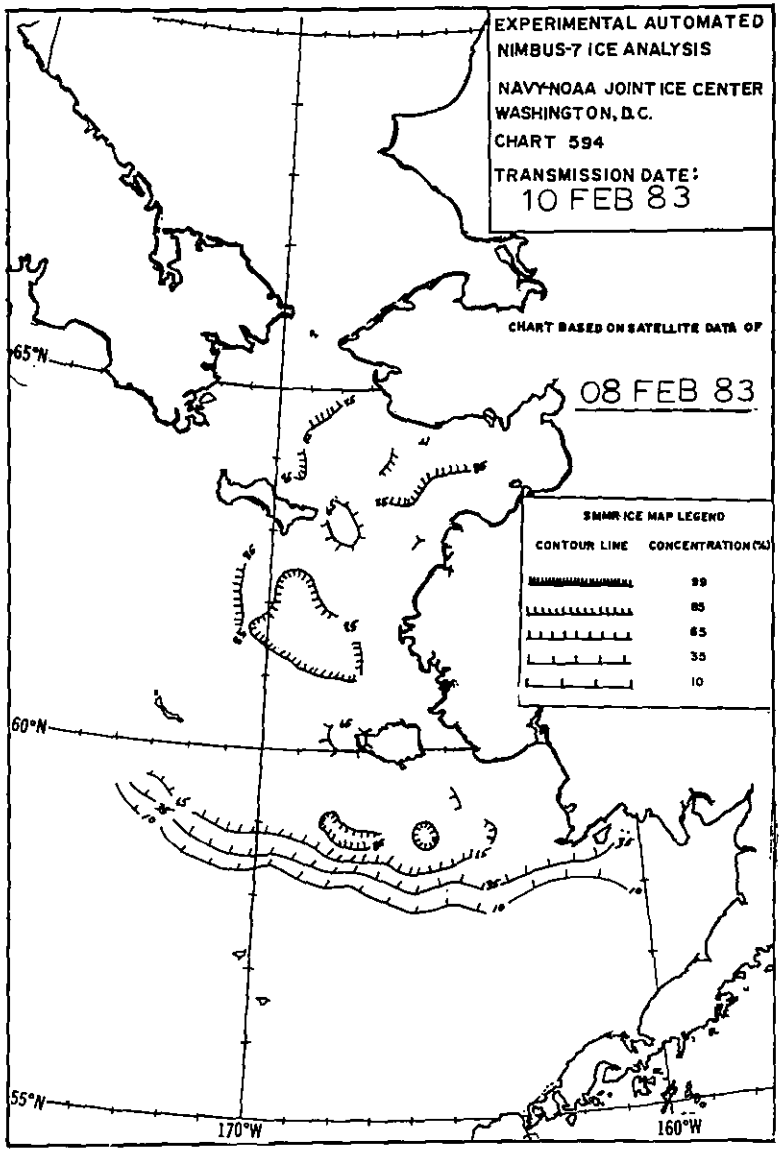
EXAMPLES OF SATELLITE-DERIVED NEAR REAL-TIME OCEANIC DATA, INFORMATION, AND SERVICES

SEA ICE AND ICE SHEETS

EXPERIMENTAL AUTOMATED NIMBUS-7 SMMR ICE ANALYSIS CHARTS

- NIMBUS-7 SMMR AUTOMATED ICE ANALYSIS CHART PRODUCED THREE TIMES A WEEK BY NAVY-NOAA JOINT ICE CENTER IS SHOWN BELOW.
- CONTOURS REPRESENT SEA ICE CONCENTRATIONS.
- THE N-ROSS AND DMSP SMM/I's WILL PROVIDE IMPROVED SEA ICE ANALYSIS CHARTS FROM THOSE PROVIDED BY SMMR.

NIMBUS-7 SMMR ICE ANALYSIS



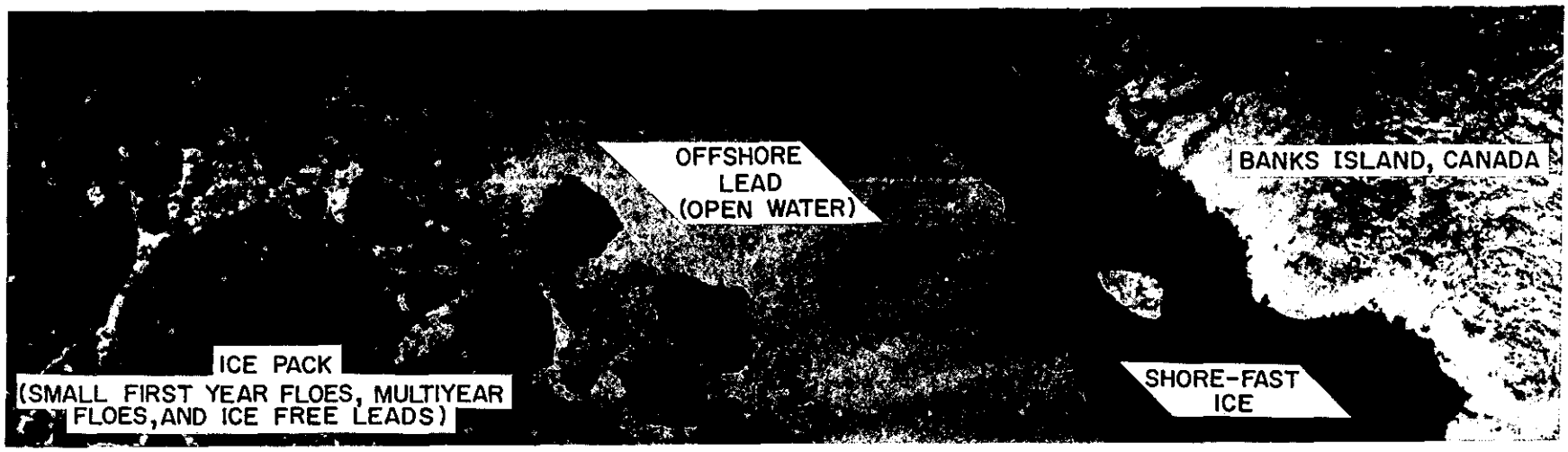
EXAMPLES OF SATELLITE-DERIVED NEAR REAL-TIME OCEANIC DATA, INFORMATION, AND SERVICES

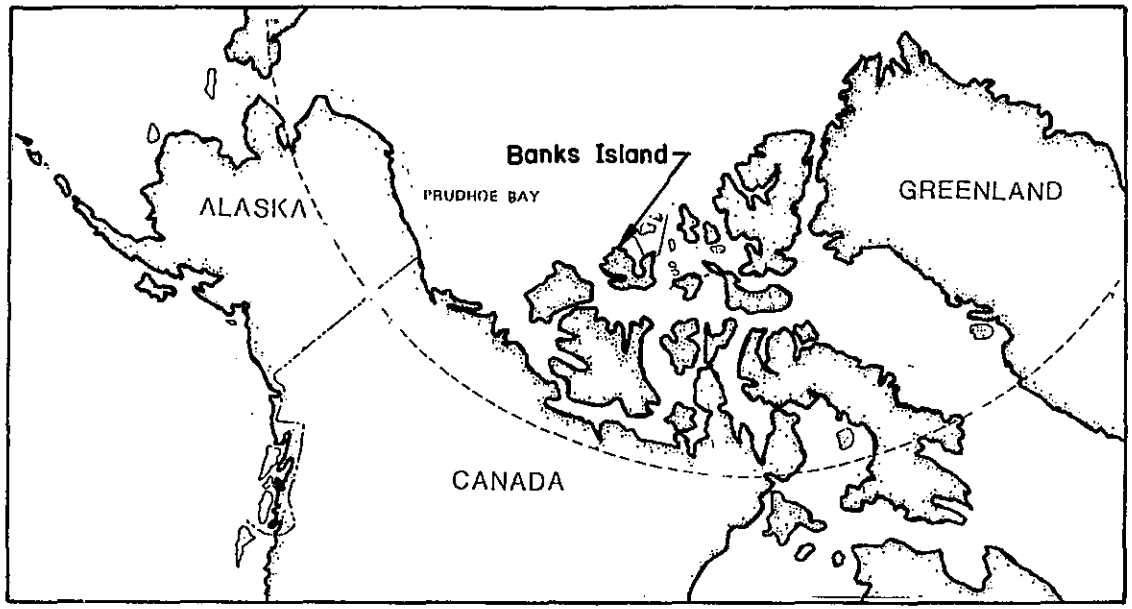
SEA ICE AND ICE SHEETS

SEA ICE MAPPING WITH SYNTHETIC APERATURE RADAR (SAR)

- SAR IMAGE OF SEA ICE OFF BANKS ISLAND, CANADA, TAKEN FROM SEASAT, 11 JULY 1978.
- IMAGE 33KM BY 135KM CONTAINS SHORE-FAST ICE (DARK AREA) WITH PRESSURE RIDGES VISIBLE AS LINEAR STREAKS.
- BRIGHT UNIFORM ZONE TO LEFT OF SHORE-FAST ICE IS SHORE LEAD. STRONG RADAR RETURN SIGNAL INDICATES A WIND-ROUGHENED SEA.
- ICE PACK EDGE CONSISTS OF SMALL FIRST-YEAR/MULTI-YEAR ICE FLOES SEPARATED BY ICE-FREE LEADS.
- WITHIN ICE PACK ARE LARGE SOLIDIFIED FLOES COMPOSED OF MIXTURE OF SMALLER FIRST-YEAR AND MULTI-YEAR FLOES WITH NUMEROUS PRESSURE RIDGES VISIBLE.
- ERS-1 SAR WILL PROVIDE DAY/NIGHT ARCTIC ICE MAPPING ON ALL WEATHER BASIS.

SEA ICE


OFFSHORE
LEAD
(OPEN WATER)
BANKS ISLAND, CANADA
ICE PACK
(SMALL FIRST YEAR FLOES, MULTIYEAR
FLOES, AND ICE FREE LEADS)
SHORE-FAST
ICE


Banks Island
PRUDHOE BAY
ALASKA
GREENLAND
CANADA

EXAMPLES OF SATELLITE-DERIVED NEAR REAL-TIME OCEANIC DATA,

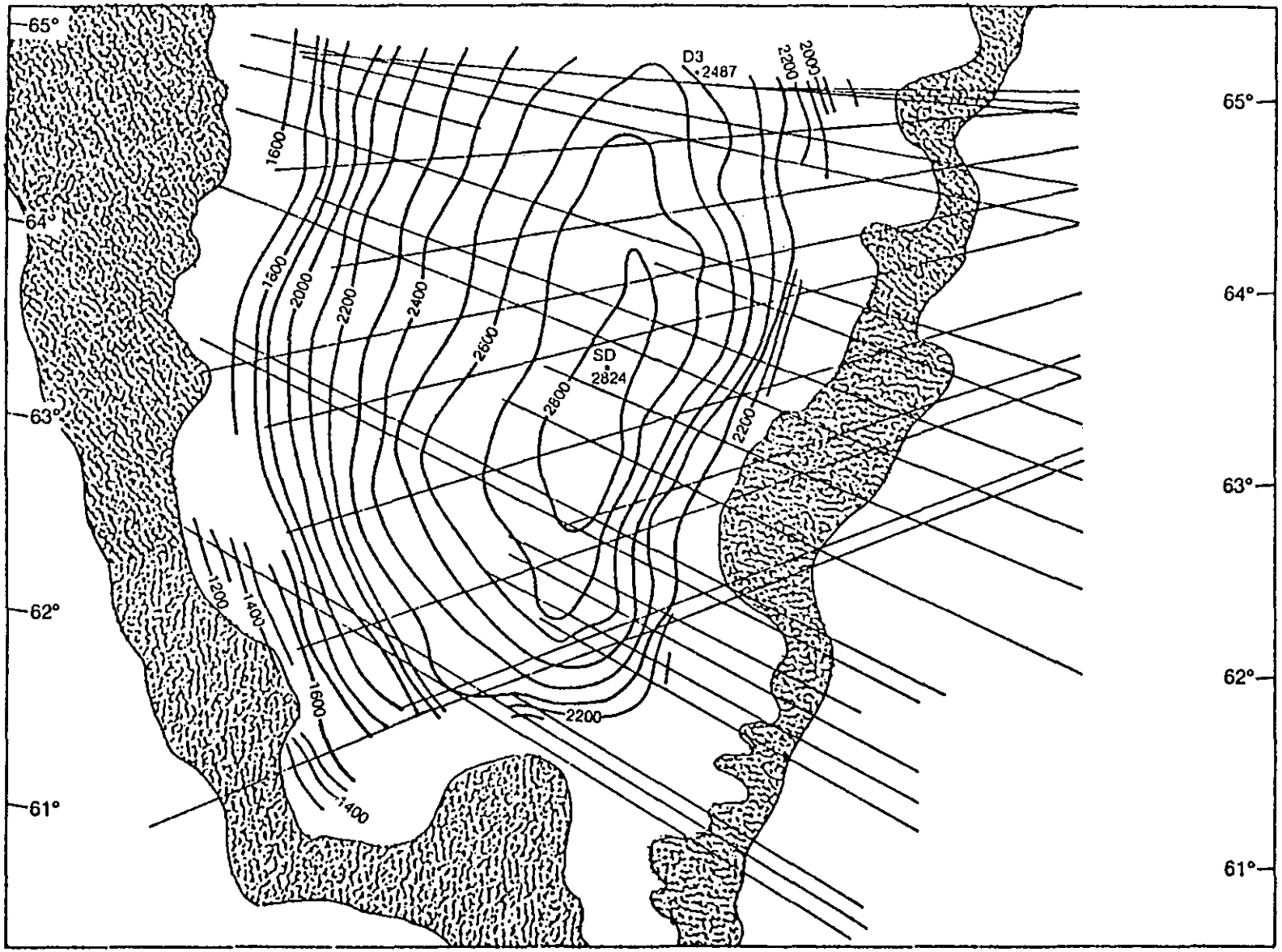
INFORMATION, AND SERVICES

SEA ICE AND ICE SHEETS

ICE SHEET MAPPING WITH SATELLITE RADAR ALTIMETER

- ALTIMETER DATA FROM SEASAT USED TO PROVIDE SURFACE ELEVATION MAP OF SOUTHERN GREENLAND ICE SHEET.
- ELEVATION REFERENCED TO SEA LEVEL AND CONTOURED AT 100M INTERVALS.
- MEASUREMENTS IMPORTANT FOR WORLD CLIMATE STUDIES.
- N-ROSS AND ERS-1 WILL PROVIDE DENSE COVERAGE OF ANTARCTIC AND GREENLAND ICE SHEETS, CONTRIBUTING TO THE STUDY OF CLIMATE VARIATIONS.

GREENLAND ICE SHEET MAP



EXAMPLES OF SATELLITE-DERIVED NEAR REAL-TIME OCEANIC DATA, INFORMATION, AND SERVICES

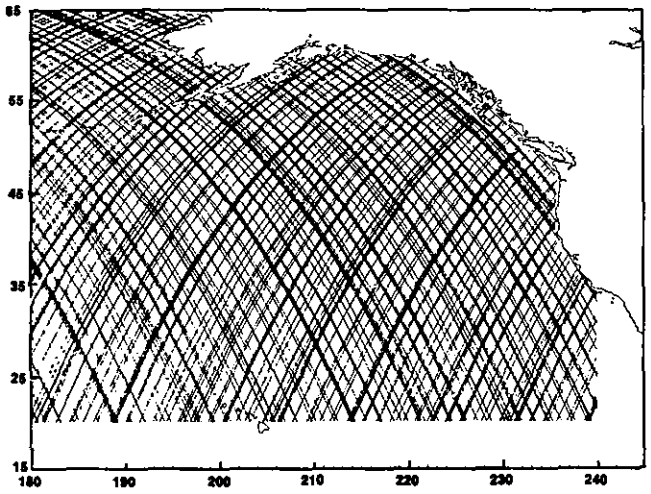
SEA SURFACE TOPOGRAPHY/CURRENTS/CIRCULATION

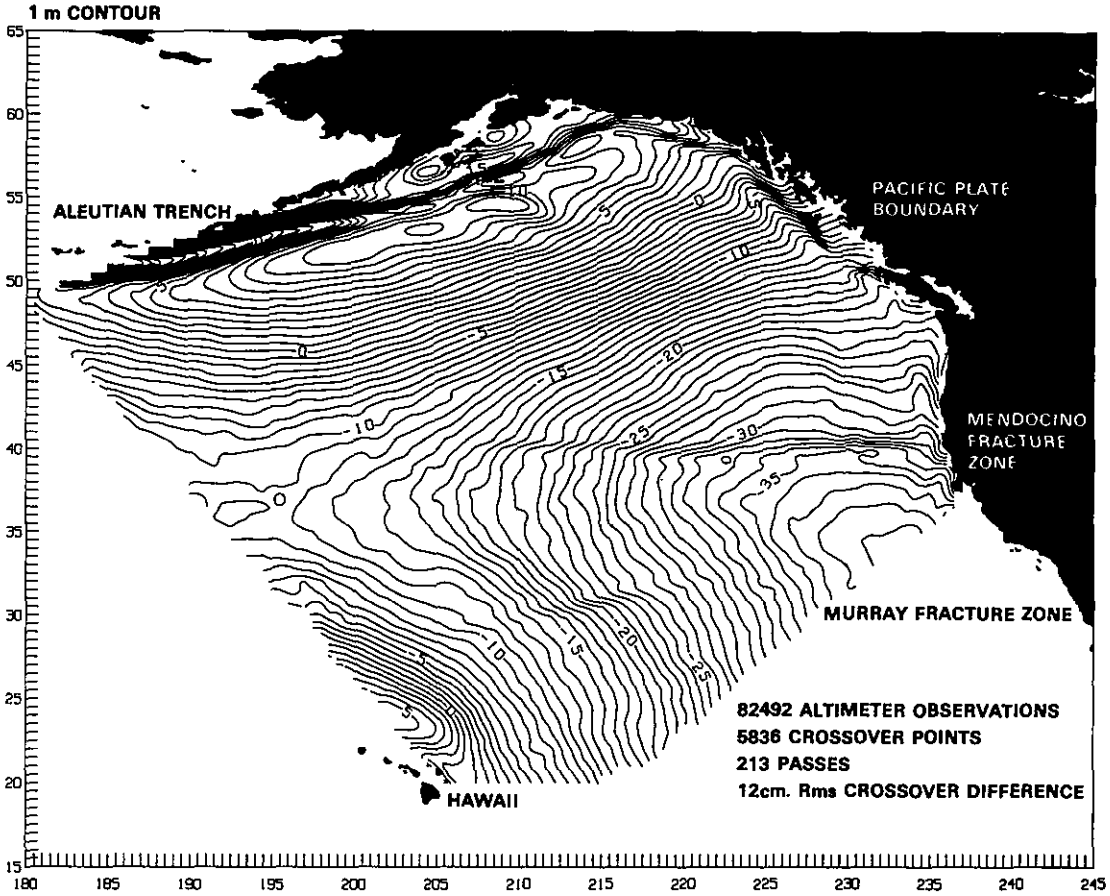
SEA SURFACE TOPOGRAPHY FROM SATELLITE RADAR ALTIMETRY

- MEAN OCEAN SURFACE TOPOGRAPHY WITH PRECISION OF LESS THAN 10-CM WAS PRODUCED FROM SEASAT ALTIMETER DATA OVER THE EASTERN PACIFIC DURING JULY-OCTOBER 1978.
- THESE DATA PERMIT DETECTION OF GEOLOGICAL FEATURES SUCH AS FRACTURE ZONES AND PLATE BOUNDARIES.
- THREE-DIMENSIONAL SEA SURFACE HEIGHT MAPS CONTRIBUTE TO KNOWLEDGE OF BOTH SOLID EARTH AND OCEAN DYNAMICS.

MEAN SEA SURFACE TOPOGRAPHY

Satellite altimeter data with a precision of the order of 5 cm. together with crossing arc techniques for orbit error removal, allow construction of highly precise regional mean surfaces. In the case of the eastern North Pacific, where mesoscale variability is not a significant factor, a mean ocean surface with precision of less than 10 cm. has been produced. This has permitted detection of geologic features such as fracture zones and plate boundaries, the first time this has been possible using an altimetric map. Such three-dimensional sea surface height maps contribute to knowledge of both the solid earth and ocean dynamics.





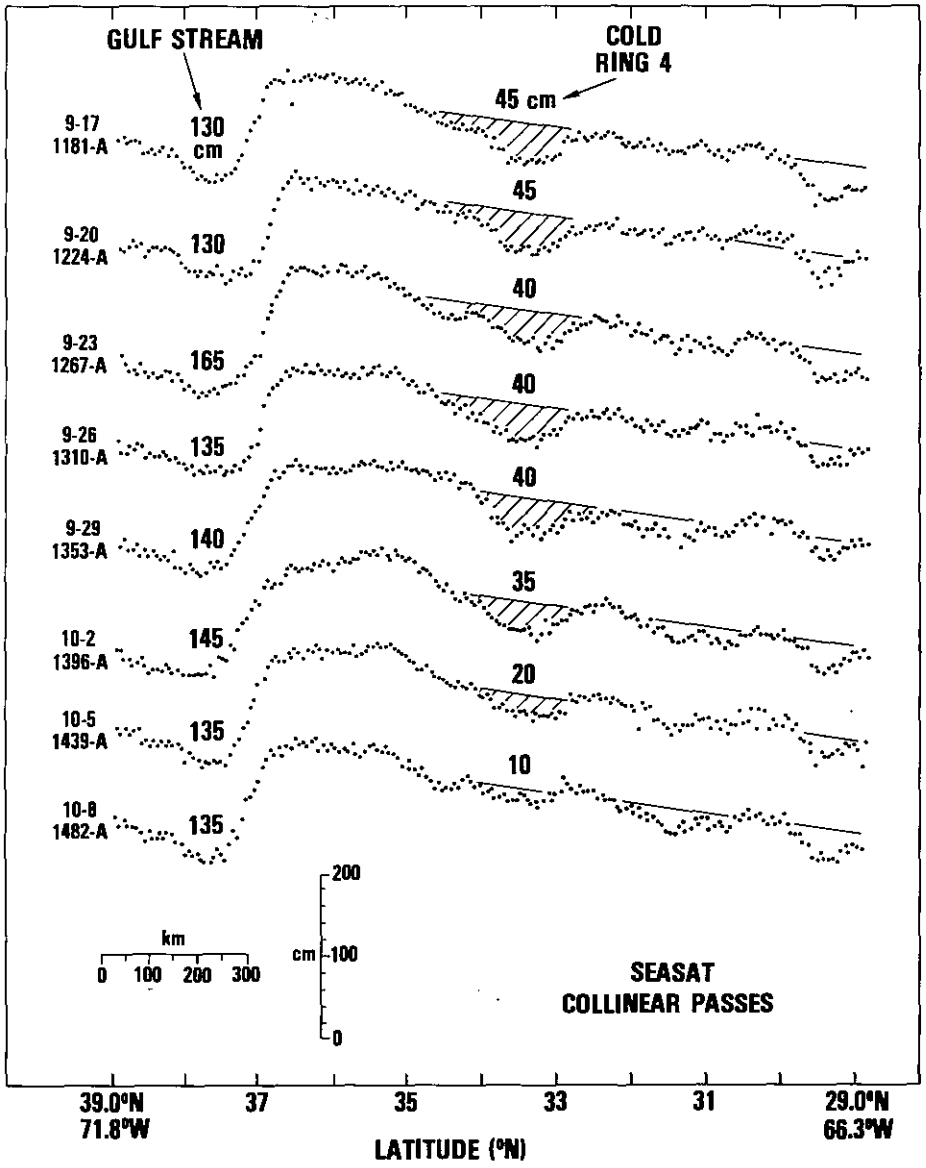
EXAMPLES OF SATELLITE-DERIVED NEAR REAL-TIME OCEANIC DATA, INFORMATION, AND SERVICES

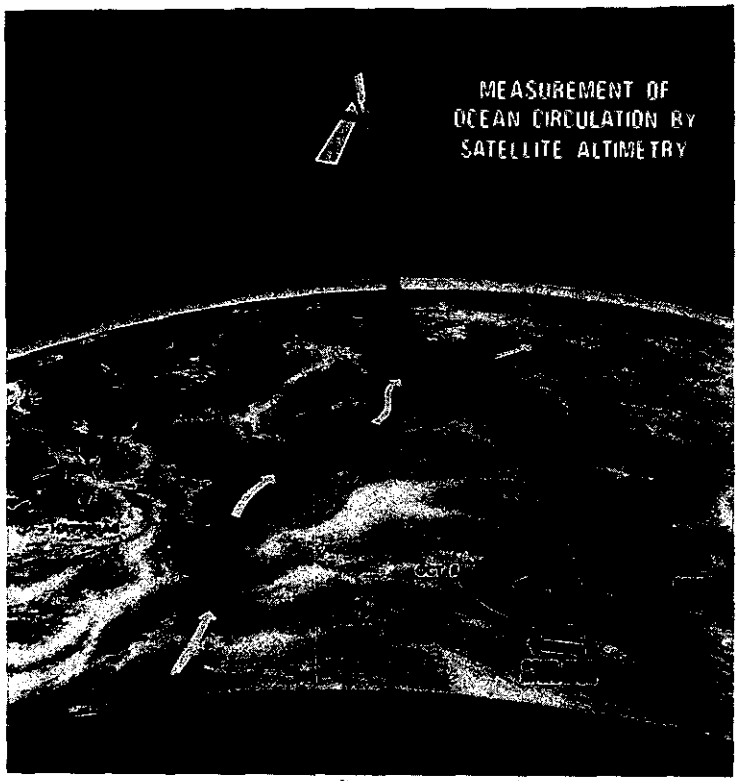
SEA SURFACE TOPOGRAPHY/CURRENTS/CIRCULATION

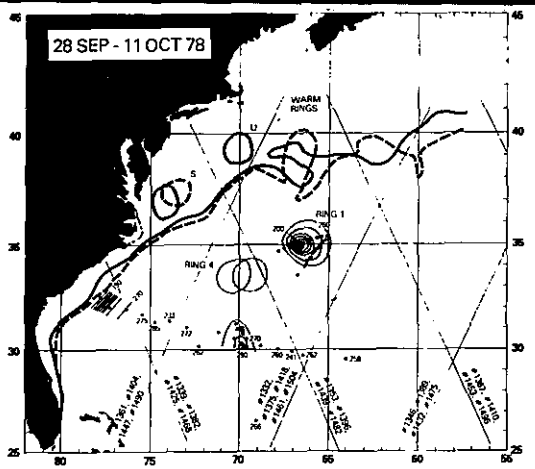
OCEAN CIRCULATION MEASUREMENTS WITH SATELLITE RADAR ALTIMETRY

- EIGHT COLLINEAR PASSES OVER WESTERN NORTH ATLANTIC BY SEASAT RADAR ALTIMETER MONITORED CHANGES IN POSITION OF GULF STREAM EDGE AND TRACKED MIGRATION OF COLD RING IN THE SARGASSO SEA.
- DETECTION AND TRACKING OF WESTERN BOUNDARY CURRENTS AND THEIR ASSOCIATED WARM AND COLD RINGS ESSENTIAL FOR GLOBAL CIRCULATION STUDIES AND CLIMATE RESEARCH.
- N-ROSS AND ERS-1 BOTH WILL CARRY RADAR ALTIMETERS FOR OCEAN CIRCULATION MEASUREMENTS.

GULF STREAM AND EDDY DYNAMICS







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SUMMARY AND ANALYSES OF THE NNEEDD ACTIVITY

REMAINING ACTIVITIES TO BE ADDRESSED
(KEY ISSUES)

- NOAA'S PARTICIPATION IN SHARED PROCESSING SYSTEM.
- OCEAN COLOR INSTRUMENT CAPABILITY.
- JOINT U.S./CANADIAN RADARSAT PROGRAM.
- INCLUSION OF JAPAN'S OCEANIC SATELLITE PROGRAMS.
- NEAR REAL-TIME APPLICATIONS OF TOPEX.
- METHODS OF DATA EXCHANGE.
  - --RAW
  - --PROCESSED LEVEL-II
  - --INTERNATIONAL
  - --OTHER

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BENEFITS

- THE AGGREGATE VALUE OF THE OCEANIC SECTOR OF THE GROSS NATIONAL PRODUCT IS AROUND THREE PERCENT. WHILE THIS MAY NOT SEEM A LARGE CONTRIBUTION, THE THREE PERCENT MAGNITUDE IS THE SAME AS THAT OF SUCH INDUSTRIES AS COMMUNICATIONS, AGRICULTURE, MINING, AND TRANSPORTATION.

- THE INTEGRATED BENEFITS OF SATELLITES TO THE OCEANIC COMMUNITY OVER THE 15-YEAR PERIOD 1985-2000 DEPENDS ON THE DISCOUNT RATE USED BUT HAS BEEN ESTIMATED AS FOLLOWS USING 1975 DOLLARS

INDUSTRY	DISCOUNT RATE	
	0%	10%
OFFSHORE OIL	1136-1824	214-344
OCEANIC MINING	NOT ESTIMATED	
COASTAL ZONES	16-432	3-81
ARCTIC OPERATIONS	635-2147	96-288
MARINE TRANSPORTATION	NOT AVAILABLE	215-525
OCEANIC FISHING	NOT AVAILABLE	274-1432
PORTS AND HARBORS	NOT AVAILABLE	0.5
	N/A - 5757	802-2670

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SUMMARY AND ANALYSES OF THE NNEEDD ACTIVITY

CONCLUSIONS

- THE PROPOSED PROGRAM IS IN RESPONSE TO GOVERNMENT, ACADEMIC, AND COMMERCIAL MARINE INTERESTS FOR NOAA TO PROVIDE A MECHANISM TO PERMIT THE CIVIL OCEANIC COMMUNITY TO HAVE ACCESS TO PLANNED SATELLITE SYSTEMS.

- THE PROPOSED PROGRAM MEETS THE MAJORITY OF USER REQUIREMENTS FOR SURFACE WINDS, TEMPERATURES, WAVES, SEA ICE, OCEAN-COLOR PRODUCTS, AND CIRCULATION, INCLUDING THE TEMPORAL REQUIREMENTS FOR GLOBAL DATA FOUR TIMES A DAY.

- THE PROPOSED PROGRAM HAS TAKEN AN APPROACH WHICH PROVIDES GREATER SERVICES THAN THE PREVIOUSLY PROPOSED NATIONAL OCEANIC SATELLITE SYSTEM (NOSS), BUT AT SIGNIFICANTLY REDUCED COST TO NOAA.

- THERE ARE OPPORTUNITIES FOR EXPANDED COOPERATION, IN PARTICULAR WITH FRANCE, CANADA, AND JAPAN FOR SATELLITE-DERIVED OCEANIC DATA, AND ALL INTERNATIONAL MARINE USERS.

(Continued from inside cover)

NESDIS 6 Spatial and Temporal Distribution of Northern Hemisphere Snow Cover. Burt J. Morse (NESDIS) and Chester F. Ropelewski, October 1983. (PB84 118348)

NESDIS 7 Fire Detection Using the NOAA--Series Satellites. Michael Matson and Stanley R. Schneider (NESDIS), Billie Aldridge and Barry Satchwell (NWS), January 1984. (PB84 176890)

NESDIS 8 Monitoring of Long Waves in the Eastern Equatorial Pacific 1981-83 Using Satellite Multi-Channel Sea Surface Temperature Charts. Richard Legeckis and William Pichel, April 1984. (PB84 190487)

NESDIS 9 The NESDIS-SEL Lear Aircraft Instruments and Data Recording System. Gilbert R. Smith, Kenneth O. Hayes, John S. Knoll, and Robert S. Koyanagi, June 1984.

NESDIS 10 Atlas of Reflectance Patterns for Uniform Earth and Cloud Surfaces (NIMBUS-7 ERB--61 Days). V.R. Taylor and L.L. Stowe. (PB8512140)

NESDIS 11 Tropical Cyclone Intensity Analysis Using Satellite Data. Vernorn F. Dvorak, September 1984. (PB85 112951)

NESDIS 12 Utilization of the Polar Platform of NASA's Space Station Program for Operational Earth Observations. John H. McElroy and Stanley R. Schneider, September 1984. (PB85 1525027AS)

NOAA SCIENTIFIC AND TECHNICAL PUBLICATIONS

The National Oceanic and Atmospheric Administration was established as part of the Department of Commerce on October 3, 1970. The mission responsibilities of NOAA are to assess the socioeconomic impact of natural and technological changes in the environment and to monitor and predict the state of the solid Earth, the oceans and their living resources, the atmosphere, and the space environment of the Earth.

The major components of NOAA regularly produce various types of scientific and technical information in the following kinds of publications:

PROFESSIONAL PAPERS—Important definitive research results, major techniques, and special investigations.

CONTRACT AND GRANT REPORTS—Reports prepared by contractors or grantees under NOAA sponsorship.

ATLAS—Presentation of analyzed data generally in the form of maps showing distribution of rainfall, chemical and physical conditions of oceans and atmosphere, distribution of fishes and marine mammals, ionospheric conditions, etc.

TECHNICAL SERVICE PUBLICATIONS—Reports containing data, observations, instructions, etc. A partial listing includes data serials; prediction and outlook periodicals; technical manuals, training papers, planning reports, and information serials; and miscellaneous technical publications.

TECHNICAL REPORTS—Journal quality with extensive details, mathematical developments, or data listings.

TECHNICAL MEMORANDUMS—Reports of preliminary, partial, or negative research or technology results, interim instructions, and the like.

Information on availability of NOAA publications can be obtained from:

PUBLICATION SERVICES BRANCH (E/AI13)
NATIONAL ENVIRONMENTAL SATELLITE, DATA, AND INFORMATION SERVICE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

Rockville, MD 20852